The MINING CONGRESS JOURNAL

Volume 11 NOVEMBER, 1925 *No.* 11

Annual Metals Edition

Western Division's Constructive Program
Annual Meeting and Program of Western Division
Development of Arizona's Great Mines
Copper's Place in the Sun
The Outlook for Silver
Increasing Use for Manganiferous Iron Ore
Consequences of the Anthracite Strike
Production and Use of Rock Dust
Handling of Materials in Underground Mining
Transportation and Distribution at Miami Copper
Haulage and Hoisting at Inspiration Consolidated
Handling Ore and Waste at the Magma Mine
Mine Track Work and Materials
The Nation's Viewpoint
News of the Mining Field
Practical Operating Men's Department

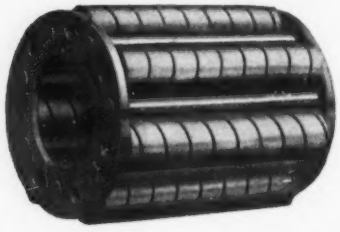
Contributors:

Chas. F. Willis, L. S. Cates, Stephen Birch, Cleveland E. Dodge, R. L. Agassiz, Gordon R. Campbell, W. Mont Ferry, Clement K. Quinn, J. Wilbur Van Evera, Carl Zapffes, E. H. Wells, Francis A. Thomson, John A. Fulton, Walter S. Palmer, A. G. Mackenzie, G. M. Butler, Arthur B. Foote, Roy Reddie, Guy N. Bjorge, A. J. McDermid, J. C. Conniff, A. C. Stoddard, F. W. Snow, Amos A. Culp, O. K. Dyer.

JOHN W. SHEERES

Four out of Five

It is worth while for you to note that *four of the five* low-cost, large out-put "model mines" use Hyatt roller bearing equipped running gear. The fifth has recently placed its first quantity order for economical Hyattized trucks.



The Five Model Mines

LYNCH MINES, U. S. Coal & Coke Co.
BELL & ZOLLER Mining Co.
ISLAND CREEK Coal Co. Mines.
UNDERWOOD COLLIERY, Penn. Coal Co.
ORIENT MINE No. 1, Wilmington & Franklin Coal Co.

Send for the Mine Car Bulletin

YOU WILL FIND a valuable store of facts and figures about Hyatt Roller Bearings in Bulletin No. 390. Contained in it also is a list of the mine car manufacturers who install Hyatt bearings. It is offered to you to supplement the services of the Hyatt mine specialists and engineers. Send for it today.

HYATT ROLLER BEARING COMPANY

NEWARK DETROIT CHICAGO SAN FRANCISCO
WORCESTER PHILADELPHIA CHARLOTTE
PITTSBURGH CLEVELAND

Keep up with Your Job

LOWER COSTS, greater safety and increased all 'round efficiency are resulting from the rapid advancement which is taking place in explosives engineering. At mines, quarries and on construction work throughout the world improvements in methods of drilling, blasting, loading, and transporting of coal, ore and stone are constantly being made, and every month some of these are reported in "The Explosives Engineer", a unique, illustrated periodical devoted to these important subjects.

NEW OFFER

Less than 3c a Month

WE are making a new offer of a three years' subscription to "The Explosives Engineer" for one dollar postpaid anywhere in the United States. This will apply to all of our present readers as well as to new subscribers. Each issue is exhausted shortly after publication, so it is advisable to send in subscriptions at once in order to secure the November number. Attach a dollar bill to the coupon and keep abreast of developments in mining, quarrying and construction for 36 months.

THE EXPLOSIVES ENGINEER
WILMINGTON DELAWARE

The November Issue

Truly amazing figures are revealed in the November issue by Daniel Harrington, eminent Consulting Engineer of Salt Lake, in his article "Coal Mine Blasting from the Surface", which describes the system of firing shots after all men are out of the mine. No one dealing with coal blasting problems should miss this story.

Other articles which contain practical, usable information are "The Zinc Mines of Mascot"; "Channeling with Hammer Drills and Rock Dusting Equipment at Dawson, New Mexico".

Otho M. Graves, President, National Crushed Stone Association, tells what that organization's recently established Engineering Bureau will mean to the crushed stone industry, and there is an inspiring short biography of Howard I. Young.

Regular features of every issue include the popular Blaster Bill and Wilyum Jan cartoons, and an index of the month's books, articles and patents on drilling, blasting and allied subjects.

MAIL THIS COUPON

The EXPLOSIVES ENGINEER,
934 Delaware Trust Bldg.,
Wilmington, Delaware

SUBSCRIPTION RATES
United States - 3 yrs. $1.00 - 1 yr. $ .50
Canada, Newfoundland, Australia 1 yr. $1.50
Other foreign countries 3 yrs. $2.00 1 yr. $1.00

I am enclosing $1.00 for a 3 years' subscription to The Explosives Engineer, to begin with the November issue if it is not already exhausted. (This rate applies only to the United States.)

Name.....

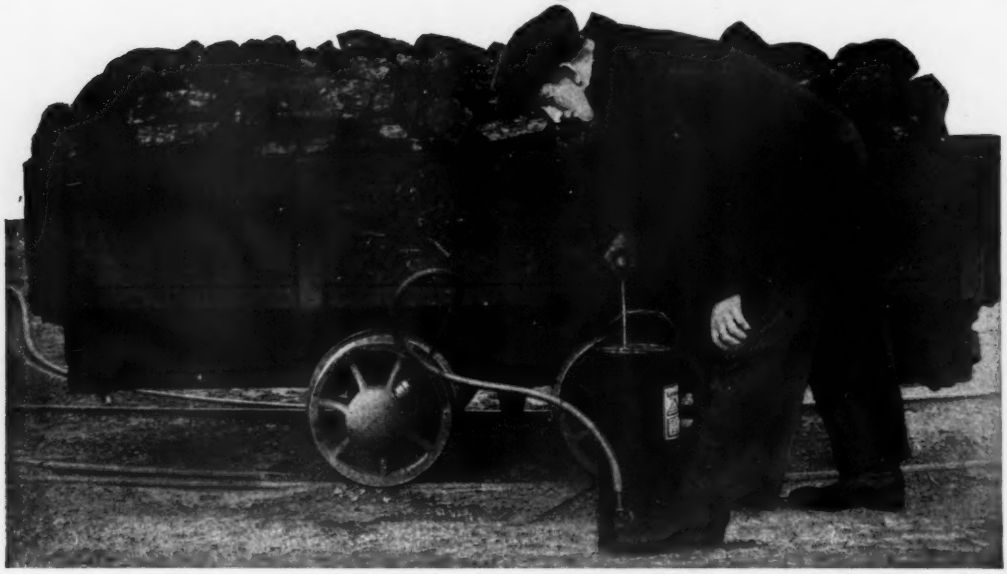
Firm Name.....

Street.....

City..... *State*.....

Please send me conditions covering the National Safety Competition for The Explosives Engineer Trophy. ☐

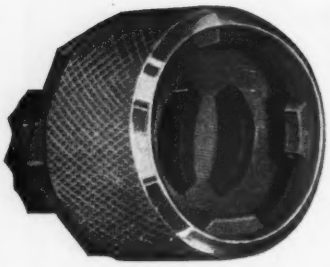
"The Lincoln Way" of Greasing Mine Cars



The Lincoln Grease Cabinet holds 25 pounds of grease — enough for from 10 to 40 wheels. The average grease gun would have to be filled from 25 to 50 times to handle the same amount of grease. This is only one of many savings.

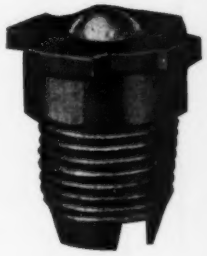
INTRODUCTORY OUTFIT

Which is as follows:



The Lincoln Standard Coupler Nozzle that fits all Lincoln Grease Plugs

80 LINCOLN Grease Plugs any size to fit your wheel (enough for 20 cars) at 25c ea.	$20.00
1 LINCOLN Greasing Cabinet (hand operated) 25 lb. capacity, with pump that delivers ¼ lb. grease per stroke 1 LINCOLN Standard Coupler Nozzle (fitted to Greasing Cabinet) that fits ALL Lincoln Grease Plugs	15.00
1 Special Grease Plug Wrench	.50
Regular Price for above	$35.50



No. 2
With ½-inch Pipe Thread

Special Price to Introduce the Lincoln Way of Greasing $25.00

Shipping Weight, 35 Pounds

Examine the outfit when it arrives. If you are not satisfied send it back and don't pay for it.

LINCOLN STEEL & FORGE CO., St. Louis, Mo.
Gentlemen: Please send us the Introductory Outfit for Greasing Mine Cars. Grease plugs must fit holes tapped for ..... inch pipe plugs or ..... inch machine screws.

Name .....
Company .....
City .....
State .....

THE LINCOLN STEEL & FORGE COMPANY
ST. LOUIS, MO.

THE MINING CONGRESS JOURNAL

NOVEMBER, 1925 CONTENTS $3.00 Per Year 30c Per Copy

EDITORIALS

Nuisance Taxes 507
No Broken Contract 507
The Wages of Mining 508
The Mining Handicap 508
Researching the Coal Industry 509
Fair Compromise 509

FEATURE ARTICLES

Western Division Work—Covers Constructive Program 510
History of the Development of Arizona's Great Mines—By Charles F. Willis 514
Annual Meeting of Western Division 523
Program, Annual Meeting, Western Division 525
Copper's Place in the Sun—By L. S. Cates, Stephen Birch, Cleveland E. Dodge, R. L. Agassiz and Gordon R. Campbell 526
Future Prospects of the Gold Mining Industry—By Arthur B. Foote 527
The Outlook for Silver—By W. Mont Ferry 528
The Increasing Use of Manganiferous Iron Ore—By Clement K. Quinn, J. Wilbur Van Evera and Carl Zapffes 529
Consequences of the Anthracite Strike—By George H. Cushing 530

PRACTICAL OPERATING MEN'S DEPARTMENT

METAL

Handling of Materials in Underground Mining

Transportation and Distribution of Supplies at Miami Copper Company

Material Haulage and Hoisting at the Inspiration Consolidated Copper Company

Transportation and Handling of Ore and Waste in the Magma Mine

COAL

Mine Track Work and Materials

Production and Use of Rock Dust

Legislative Forecast 532
New Mexico's Future Mineral Production—By E. H. Wells 533
The Future of Idaho as a Mineral Producer—By Francis A. Thomson 536
The Future of Nevada as a Mineral Producer—By John A. Fulton 539
Non-Metallics in Nevada—By Walter S. Palmer 540
Utah's Mineral Future—By A. G. Mackenzie 541
The Development of Arizona's Mining College—By G. M. Butler 542
Production and Use of Rock Dust—By Roy Reddie 547
Handling of Materials in Underground Mining—By Guy N. Bjorge 554
Transportation and Distribution of Supplies at Miami Copper Company—By A. J. McDermid and J. C. Conniff 555
Material Haulage and Hoisting at the Inspiration Consolidated Copper Company—By A. C. Stoddard 559
Transportation and Handling of Ore and Waste in the Magma Mine—By Frederick W. Snow 562
Mine Track Work and Materials—By Amos A. Culp 564
Standardized Mine Ventilation Equipment—By O. K. Dyer 570

DEPARTMENTS

PRACTICAL OPERATING MEN'S DEPARTMENT, METALS 554
PRACTICAL OPERATING MEN'S DEPARTMENT, COAL 564
THE NATION'S VIEWPOINT 567
NEWS OF THE MINING FIELD 573
WITH THE MANUFACTURERS 577
PERSONAL ITEMS 578

NEWS

Tailings Damage Suit 513
Cementation of Copper by Sponge Iron 528
Warriner Replies to Lewis' Charges 531
Scott Turner New Mines Bureau Director 532
Barium Polysulphide as a Sulphidizing Reagent 535
Production of Steel by Direct Process 538
California's Mineral Industries in 1924 541
Mine Safety Studies 544
Prospecting for Minerals in Arizona 545
The Air Mail 570
Revolving Screens for Mine Use 571
Types of Flotation Reagents 571
Leasing Work Reorganized 571
Underground Mining of Limestone 572

ILLUSTRATIONS

Tidal Basin, Washington, D. C. ..... Insert
Scenes along the Apache Trail ..... Insert
Robert E. Tally, F. W. Maclennan, T. O. McGrath, P. G. Beckett 510
Louis S. Cates, W. S. Boyd, T. H. O'Brien, W. G. McBride, G. M. Colvocoresses, Julius Kruttschnitt, Jr. ... 511
George A. Stahl, Bruce C. Yates, W. J. Loring, John M. Sully, Emmet D. Boyle, A. P. Ramstedt 512
Directors, Arizona Chepter, American Mining Congress 513
Inspiration Consolidated Copper 514
Miami Copper Plant 515
Phelps Dodge Plant, Bisbee 516
Phelps Dodge Operations, Sacramento Hill 517
Morenci Branch, Phelps Dodge Corporation 518
Ball Mills and Flotation, Inspiration Consolidated Copper Co. 519
Ray Consolidated Copper Company 520
Magma Smelter 521
Ray Consolidated Ball Mills 521
United Eastern Mine and Oatman 522
Tom Reed Mill 522
Scenes in Phoenix and Globe, Arizona 523
Fish Creek Canyon, Apache Trail 524
Roosevelt Lake 525
Silver King Mine, Utah 528
Clement K. Quinn 529
Mahnomen Mining Company, Minnesota 529
Chino Branch, Ray Consolidated Copper Co., New Mexico 533
Wallace, Idaho 536
Hecla Mine, Bunker Hill & Sullivan and Hercules Mill 537
American Phosphate Corp. 538
Mason Valley Mines Co., Nevada 539
Tintic Standard Mining Co., Eureka, Utah 541
College Buildings, University of Arizona 542, 543
G. M. Butler 544
Rock Dusting Machines and Rock Dust Grinding Mills 547–553
Haulage Tunnel, Ray Consolidated Copper Co. 554
Supply Distribution Photographs, Miami Copper Co. 555, 558
Concentrator, Inspiration Consolidated Copper Co. 559
Diagrams, Ore Handling Methods, Magma Copper Co. 562, 563
Good and Bad Track Equipment 564, 565
Big Jim and Oatman Gold Mines, Arizona 571
Lest We Forget That This is November 578

Published Every Month by the American Mining Congress, Washington, D. C.

JAMES F. CALLBREATH
Editor-in-Chief

E. R. COOMBES
Editor

MCKINLEY W. KRIEGH
Assistant Editor

GUY N. BJORGE
Associate Editor

ERNEST H. PULLMAN
Legislative Editor

F. E. PRIOR
Art Editor

E. C. PORTER
Advertising and Business Manager

L. R. HUDSON
Field Representative

Entered as Second Class Mail Matter January 30, 1915, at the Post Office at Washington, D. C.

What Are Your Own Freight Rates?

Every piece of haulage equipment adds its bit toward the economy or high cost of mine production. Efficient design and proper material in everything from fish plates to locomotives increases appreciably the lasting quality or facilitates train movement.

Perhaps in some parts of your mine mules can be used to best advantage—in others heavy duty storage battery and trolley locomotives. But no matter what the rest of your equipment is, it all rolls on tracks—the foundation of mine haulage.

Central mine track equipment is designed to facilitate car and locomotive movement with a minimum of tie-ups. It is made of high grade materials that insure long trouble-free service. Its standard design helps the trackman to shift his track materials readily and to make quick replacements.

Immediate shipments from our "Central" location.
Send us your next rush order.

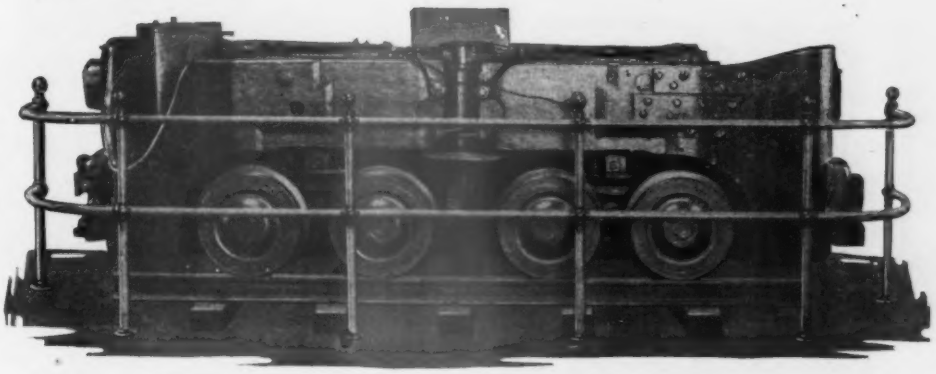
THE CENTRAL FROG & SWITCH CO.
CINCINNATI, OHIO

CENTRAL
MINE TRACK EQUIPMENT

Parallel switch stand with spring connecting rod: Type J. The lever of this stand operates parallel with the track.

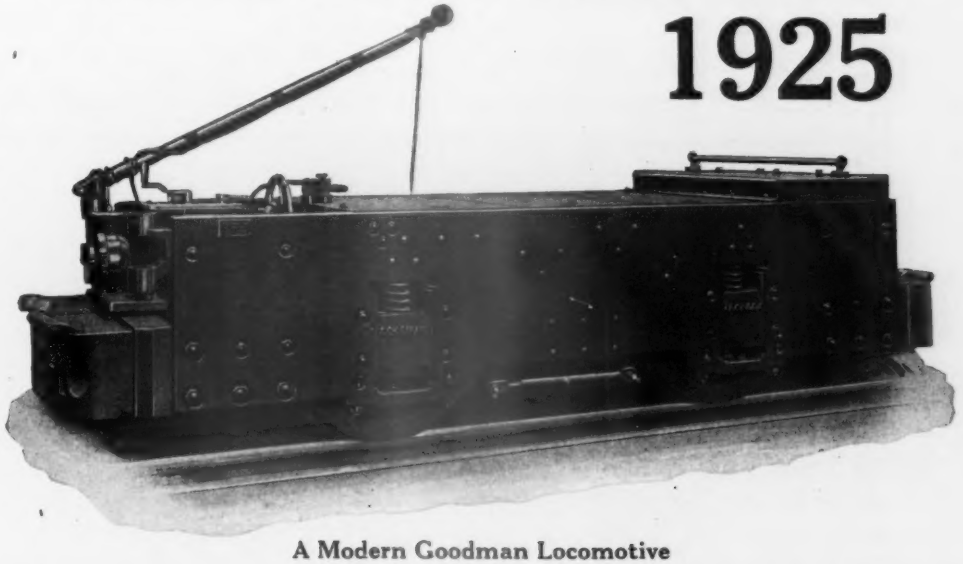
Located **FOR SERVICE — *Equipped* FOR SERVICE**

1892



This electric locomotive was one of the first used in coal mines. It was built in 1892, sold to the Northern Fuel Company, Jacksonville, Ohio, and used continuously for 18 years. It is now on exhibition as a historical relic at the Goodman factory.

1925



A Modern Goodman Locomotive

BUILDERS OF LOCOMOTIVES FOR 33 YEARS

Write for Catalogs . . . . . Books 220 and 230

GOODMAN MANUFACTURING COMPANY

PITTSBURGH CHARLESTON, W.VA. ST. LOUIS DENVER

4746 to 4854 South Halsted Street CHICAGO, ILL.

CINCINNATI HUNTINGTON, W.VA. BIRMINGHAM

(2)

CONVEYING MACHINERY

A Few of Weller Products

APRON CONVEYORS	BUCKET ELEVATORS	SCREENS
BELT CONVEYORS	ELEVATOR BUCKETS	GRIZZLIES
BUCKET CONVEYORS	SKIP HOISTS	SPROCKETS
CHAIN CONVEYORS	WEIGH LARRIES	GEARS
SPIRAL CONVEYORS	COAL CRUSHERS	BEARINGS
FEEDERS (ALL KINDS)	CAR HAUL CHAIN	BINGATES

SHEET METAL AND STRUCTURAL STEEL WORK

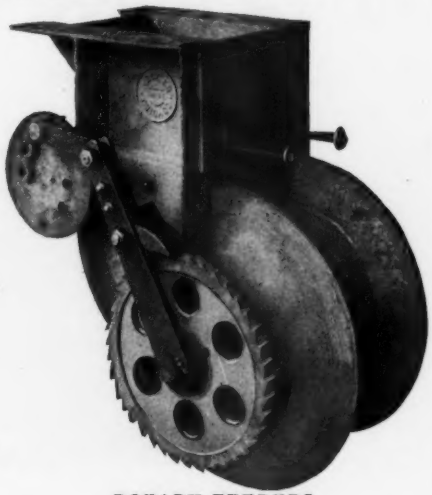
Catalogs on Request

WELLER SPIRAL CONVEYORS

Cold Rolled Steel, Sectional Flights, Wear Long

We Also Make

Spiral and Ribbon Conveyors of Monel Metal



ROTARY FEEDERS

Large Capacity Adapted for Material Over 6 inches in Diameter

WELLER MFG. CO.

1820-1856 N. KOSTNER AVE. CHICAGO, ILL.

Sales Offices

NEW YORK BOSTON BALTIMORE BUFFALO PITTSBURGH DETROIT
ST. LOUIS OMAHA SALT LAKE CITY SAN FRANCISCO

NEWS

Mining news, much of it not available otherwise, supplied promptly through our daily or weekly news bulletins, is one of the valuable services rendered by the American Mining Congress.

Authentic reports of congressional and departmental activities sent to you daily keep you promptly informed on all legislation, rulings, decisions and governmental news of importance to the industry.

ONE OF OUR SERVICES TO THE MINING INDUSTRY

Many of the little items of today from the daily bulletin will be big news tomorrow—you should keep in touch with them as well as with the regular run of governmental activities that concern mining.

Send for information about the daily and weekly bulletin services.

THE AMERICAN MINING CONGRESS

841 MUNSEY BUILDING, WASHINGTON, D. C.

From One Miner to Another

Because of its own experience, Anaconda is peculiarly fitted to advise on the use of Trolley Wire in mine service.

Anaconda Trolley Wire is tough, strong and durable. Its conductivity is unexcelled because it is made of Anaconda Electrolytic Copper over 99.9% pure.

Five Wire Mills—at Ansonia, Conn., Waterbury, Conn., Hastings-on-Hudson, N. Y., Kenosha, Wis., and Great Falls, Mont., offer a coast-to-coast service unequalled for promptness and dependability.

ANACONDA from mine to consumer

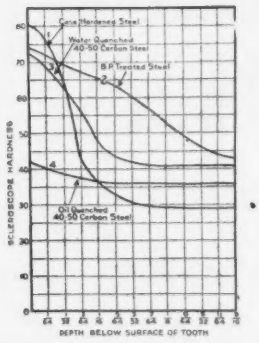
WIRE PRODUCTS
Copper Wire
Solid or Stranded
Bare, Weatherproof and Slow Burning
Varnished Cambric Cable
Lead and Braid Covered
Paper Lead Cable
Trolley Wire
Copper and Hitenso

ANACONDA COPPER MINING CO.
THE AMERICAN BRASS COMPANY
Rod, Wire and Cable Products
General Offices: 25 Broadway, New York
Chicago Office: 111 W. Washington St.

ANACONDA TROLLEY WIRE

Nuttall Helical Gears replacing the spur gears originally furnished with this mine hoist. Noise, vibration and wear practically eliminated.

The BP Special Treatment Guarantee



The curves on the diagram show the falling away of hardness on the different grades of treated gears. Readings were obtained by grinding the top of the teeth in a gradual slope so that one end of the tooth was ground down to the pitch line. Scleroscope hardness tests were made on this ground surface at one-quarter inch intervals giving the hardness readings at various depths.

BP Special Heat Treatment deserves to be enlarged upon because of the startling results it produces and the unusual guarantee and economy it makes possible. The Nuttall Company guarantees its BP Processed Gearing to give at least *four times* the service life of standard untreated cast steel gears in identical service.

The heavy duties required of gears—the loads, the shocks, the wear—have overreached the capacity of unalloyed untreated steels. There are two successful methods of meeting this need—by using alloyed steel and by heat treatment of ordinary carbon steel. The first cost and the cost of machining alloy steels makes them unnecessarily expensive. Several well known methods of heat treatment have met the need more economically. And now the BP Special Process has so increased the life, service and economy of gears that we can make this unusual guarantee.

We will treat for you other machine parts that wear unduly or break readily. Send for catalog descriptive of this process and of the smooth running qualities of Nuttall Helical Gears.

Philadelphia Office:
WESTINGHOUSE BUILDING
30th and Walnut Sts.

R.D. NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

Chicago Office:
2123 CONWAY BUILDING

Nuttall

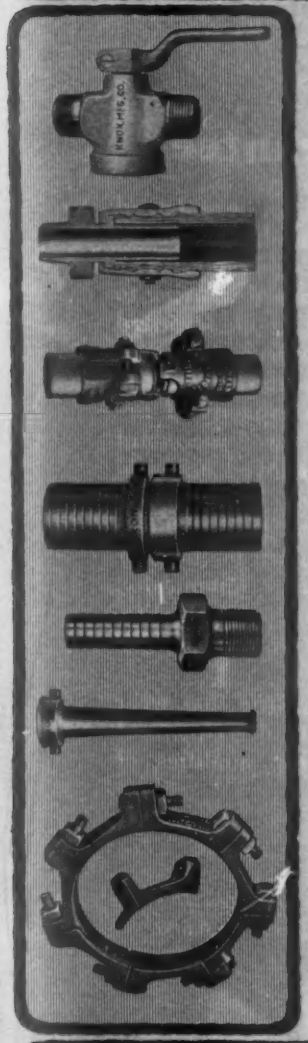
WORLD'S LARGEST MANUFACTURER OF DIVERSIFIED GEARS

KNOX

Valves-Couplings-Nipples-Clamps-Menders

MINING SPECIALTIES

The World's Standard



HIGH PRESSURE SALESMEN

IN YOUR OFFICE

OR

KNOX PRODUCTS

IN YOUR MINE

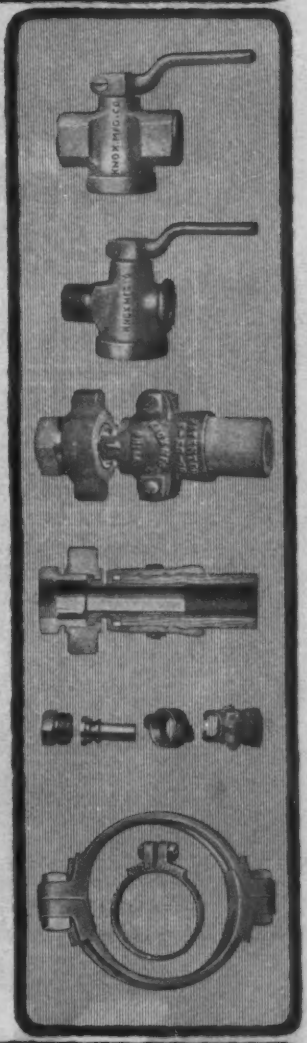
Just a comparison involving your own time

All we ask of you is to give KNOX a trial

A few minutes spent in dictating a request for samples; after that you have only to sign the orders.

KNOX PRODUCTS sell themselves. Make us prove it.

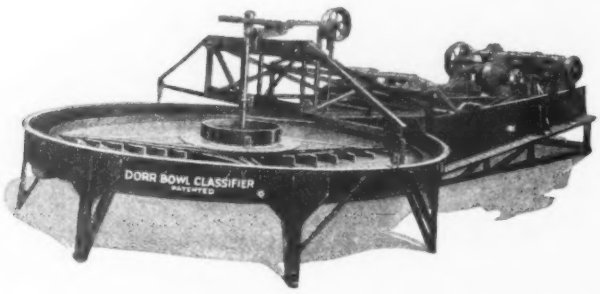
Did you know we also make special fittings to your specifications?



KNOX MANUFACTURING CO.

INCORPORATED 1911

821 Cherry St. Philadelphia, Pa.



In the Metallurgical field, DORR equipment is accepted as a standard.

Get the greatest ore extraction with the DORR Bowl Classifier

Greater overflow capacity, finer and cleaner separation, more tonnage with practically no additional power cost are the advantages, in brief, you secure by the use of the Dorr Bowl Classifier.

The two stages of classification, the first in the bowl and the second in the rake compartment, and the counter current flow of wash water combine to give a clean and sharp separation. The large area and long overflow weir provided by the bowl permits fine separations and large overflow capacity.

The Bowl Classifier is used widely in closed circuit grinding, washing, and for the separation of primary slimes in flotation and cyanide plants, as well as the dewatering of heavy solids like zinc and lead concentrates.

Write for full information

DORRCO

This symbol identifies all DORR equipment

THE DORR COMPANY

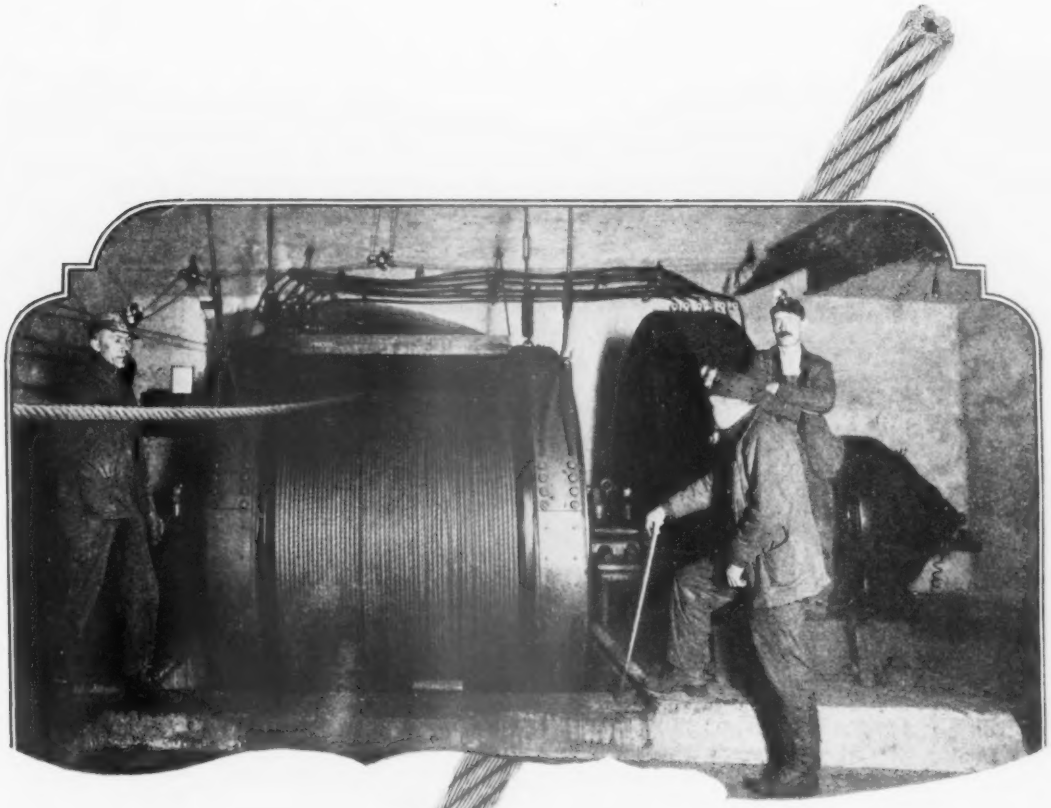
ENGINEERS

247 Park Avenue New York City

Denver, 1009 17th St. London, 16 South St., E.C.2

Chicago, 310 South Michigan Ave. Wilkes-Barre, 536 Miners' Bank Bldg, Los Angeles, 108 West 6th St.

INVESTIGATION TESTS DESIGN EQUIPMENT



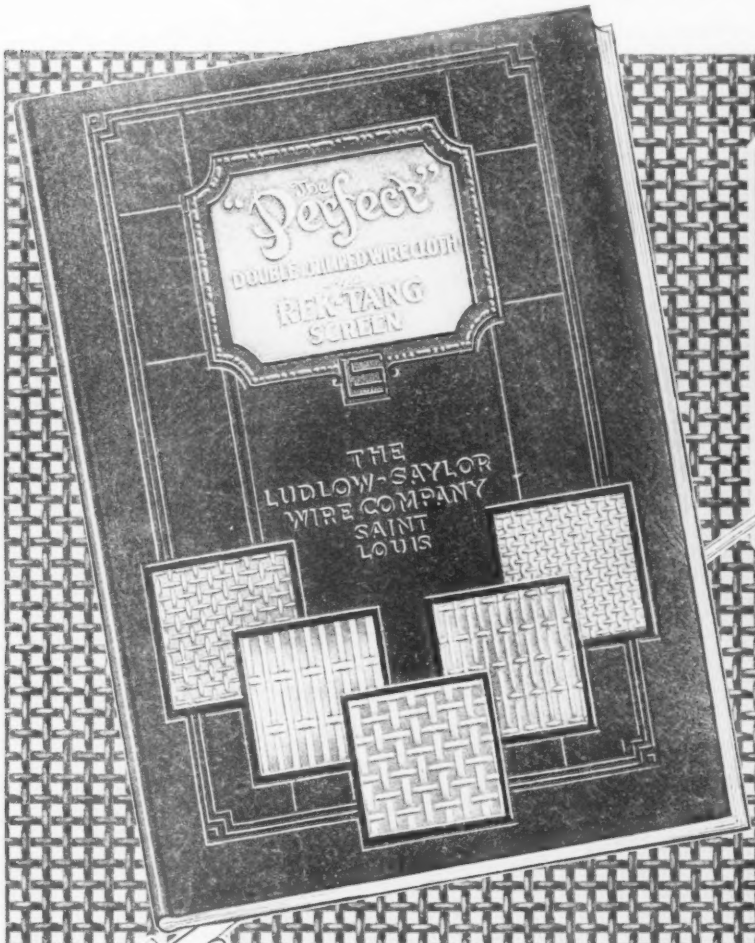
Wire Rope of Quality

Roebling Blue Center Steel Wire Rope is the ultimate choice of discriminating buyers, for every purpose for which wire rope is used.

In mining, exceptional conditions exist which must be met by the use of wire rope possessing exceptional qualities. Roebling Rope, by its long continuous service, has proven that it possesses these qualities.

John A. Roebling's Sons Company

TRENTON, NEW JERSEY



"Perfect" Service

1 Most **COMPLETE** wire cloth **SERVICE**
2 Most **ACCESSIBLE** wire cloth **SERVICE**
3 Most **RELIABLE** wire cloth **SERVICE**
4 Most **ADAPTABLE** wire cloth **SERVICE**
5 Most **ECONOMICAL** wire cloth **SERVICE**

MEMO
The Ludlow-Saylor Wire Co.,
608 So. Newstead Ave., St. Louis.

Send us one copy of Catalogue No. 47 D4, which lists The Thousand "Perfect" Screens.

Firm .....
By .....
Street .....
City .....

Ludlow-Saylor Wire Cloth

properly selected and applied to your equipment, will **screen more feed, take out more fines,** and ***raise the average effectiveness of every subsequent process.***

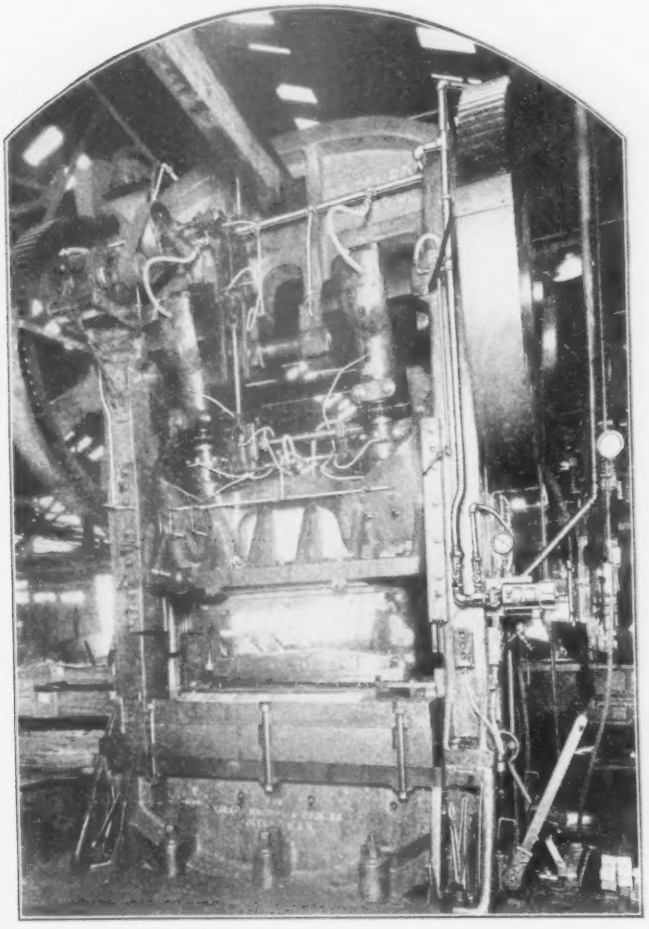
Our new catalogue No. 47 D4 is a Text-book on Screens

Get your copy from the first edition

"The city surrounded by the United States"

The LUDLOW-SAYLOR WIRE COMPANY St. Louis

608 South Newstead Avenue

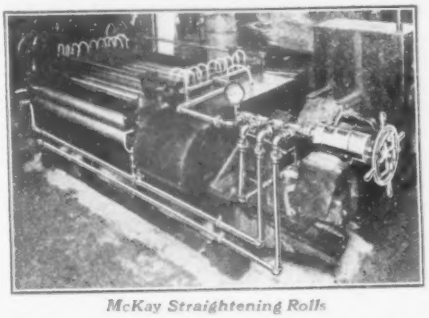


Keystone multiple, force feed Grease Lubricating System installed on a 750 ton Toledo Press.

And on these machines–

RECORDS show, after careful checking, that the investment made in installing the Keystone Safety System of Keystone Grease Lubrication on the following machines, was returned within six months to a year.

Mosser Grinder Rolls (Cement)
Calenders (Rubber)
Calenders (Textile)
Shaker Conveyor Screen (Linoleum)
Paper Dryers (Steam glands)
Rotary Kiln (metal heat treating)
Tube Straightener
Scarfers
Cabinet Planer
Bliss Press
Walton Cork Grinder
Medart Straightener
Sinkler & Davis Band Saw
Inlaid Machine (Linoleum)
Dumping Kettles (Linoleum)
Lap Weld Finishing Mill
Cranes
Butterworth Dryers
Banbury Rubber Mixer
Shartle Stuff Pump
Mine Locomotives



McKay Straightening Rolls

Boring Mills (Metal)
Water Turbine
Shears (Metal)
Charcoal Elevator
Fire Engine Pump
Locomotive Crane
Joy Coal Loader
Beloit Pasting Machine No. 5
Gang Saws
Trimmers
Ore Bridge
Rag Cutter
Charging Rolls
Shear Table
Mill Motor

KEYSTONE SAFETY SYSTEM
of KEYSTONE GREASE LUBRICATION

Send coupon for FREE booklet

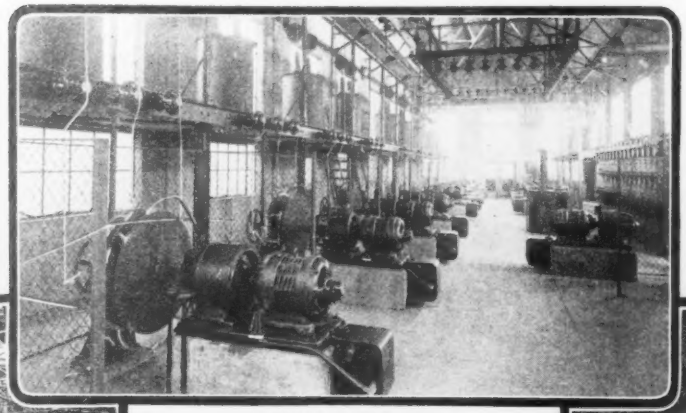
KEYSTONE LUBRICATING CO.
Philadelphia, Pa.

Gentlemen: Your system interests me. If it is all you say it is, we want further information—send it to

Name .....

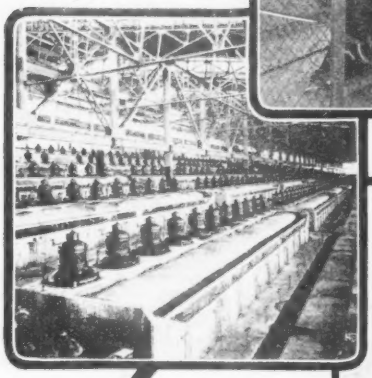
Company .....

Address .....

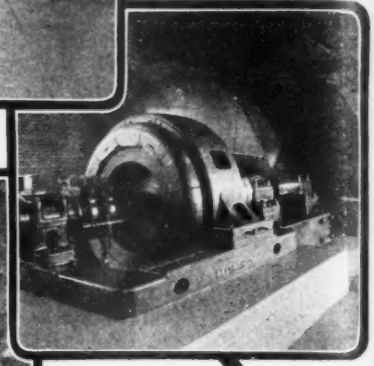


Hoisting equipment

Westinghouse motors driving flotation machines



15 kv-a. Electrical precipitation equipment



Marion shovel, Model 92, with Westinghouse equipment

Your Problem

YOUR problem is to find methods for increasing production, reducing mining costs, and effecting economies of operation which reduce overhead and add a larger percentage of profits to your investment.

Electrification is a proved means of securing these economies in the mine, mill, smelter, and refinery. Electric power is more efficient than steam; it is more economical, and it possesses more operating conveniences.

In the metal mining as well as other fields, Westinghouse has been a pioneer in furthering electrification. Your problems have been our problems and your progress our progress.

Delegates to the Mining Congress will see Westinghouse motors and control, power generating and transforming equipment, Westinghouse equipped hoists and locomotives, in service in many of the mining properties to be visited. Westinghouse equipment is reducing mining costs through economical and dependable service.

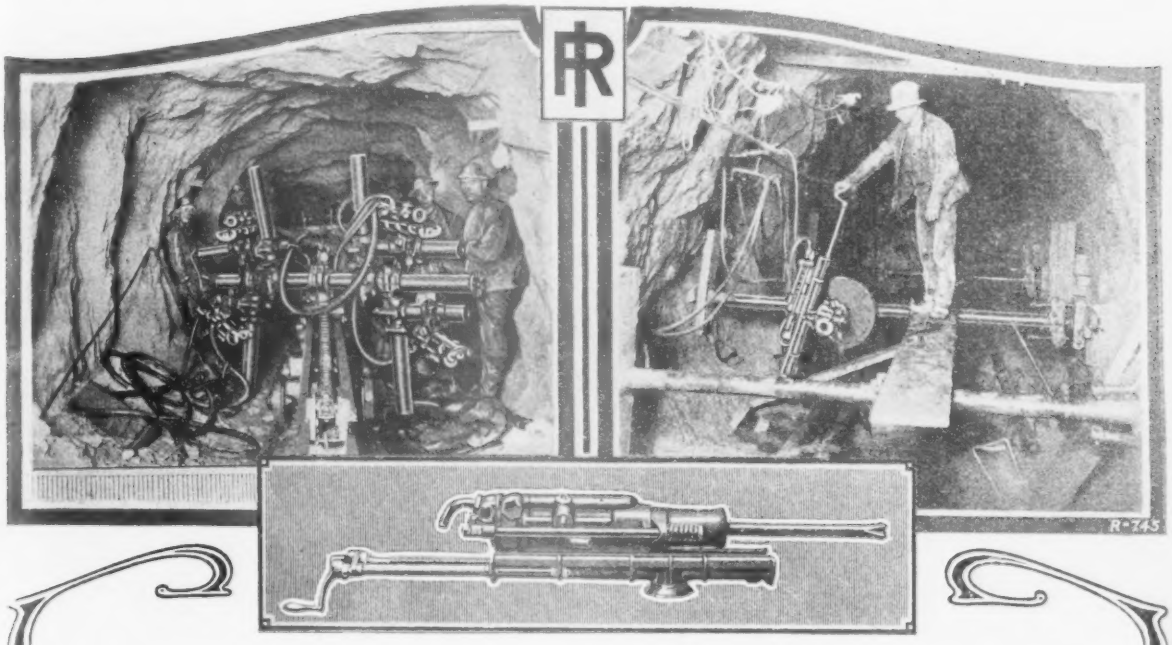
Look for the Westinghouse equipment in the mines you visit!

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the
United States and Foreign Countries

W
WESTINGHOUSE ELECTRIC

Westinghouse

X6/164



Moffat Tunnel is being driven by "Leyner-Ingersoll" Drifters

"Leyner-Ingersoll" R-72 Drifters are used at both portals of the Moffat Tunnel. The very severe service to which these drills were first subjected established the fact the R-72 is more powerful, is faster, and has less vibration and greater durability than any other rock drill tried on that work.

The R-72 Drifter is perfectly balanced. It is of simple, rugged construction with no projections. It is ideal for top holes and lifters. It has double exhaust ports, an efficient lubricating system, and unusual hole-cleaning facilities.

In addition to the R-72 Drifters, the following Ingersoll-Rand products are employed in driving the Tunnel:

Air Compressors
"Leyner" Sharpeners
"Leyner" Shank and Bit Punches
I-R Oil Furnaces, and
I-R Pedestal Grinders

We will gladly send you complete information concerning any of the foregoing equipment.

INGERSOLL-RAND COMPANY—11 BROADWAY, NEW YORK CITY.

Offices in principal cities the world over

FOR CANADA REFER—CANADIAN INGERSOLL-RAND CO. LIMITED, 260 ST. JAMES STREET, MONTREAL, QUEBEC.

Ingersoll-Rand

169-L1

MANCHA'S LITTLE TRAMMER
The Multi-Level Locomotive

MANCHA'S LITTLE TRAMMER will run onto a small mine cage and go to any level like a mine car. It can even be pulled up most raises to work on sub-levels. It will work wherever it is placed, without electrifications except for battery charging which can be done on the surface.

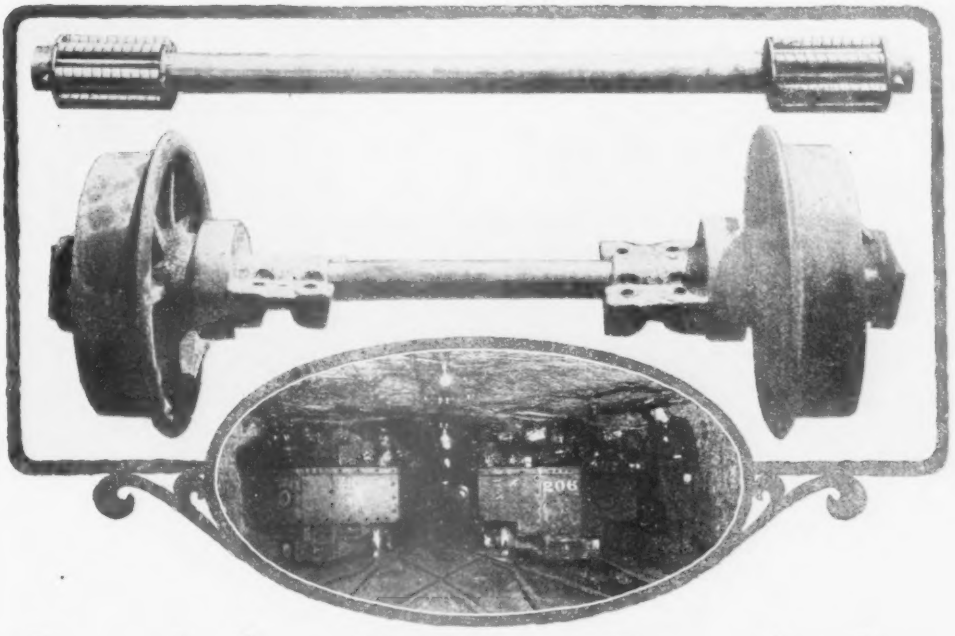
We offer it to the mining public to cut tramming costs which mount higher month by month and seems likely to continue to do so.

The application of its astonishing capacity to your mine deserves your consideration.

MANCHA STORAGE BATTERY LOCOMOTIVE COMPANY

SAINT LOUIS
MISSOURI
U. S. A.

The Mancha Storage Battery Locomotive Co.



Steel for Mine Car Axles

Any combination of alloying elements possesses certain limiting factors which decide its suitability for a particular purpose.

Our UMA No. 3 Steel can be water quenched in sections over one and one-half inches in diameter, such as mine car axles, and the penetration is such that little variation in physical properties between outside and inside can be found.

The composition is such that in thin sections the steel is oil hardening. UMA No. 3 is, therefore, well suited to the manufacture of small oil hardened gears whose clean machined surfaces harden uniformly with practically no distortion.

Where the material is scaled from forging or annealing, less hardness is obtained when oil quenched. This fact should be considered in oil hardened axles, steering arms and steering knuckles.

Complete descriptions and charts covering our entire UMA series — made *only* by us — will be found in our Agathon Alloy Steel handbook. It is sent on request.

We also have daily production in all kinds of Agathon Alloy Steels such as—

Nickel, Chrome-Nickel, Molybdenum, Chrome-Molybdenum, Nickel-Molybdenum, Vanadium, Chrome-Vanadium, Chromium, etc.

Deliveries in Blooms, Billets, Slabs, Hot Rolled, Heat Treated, and Cold Drawn Bars, Hot Rolled Strips, etc.

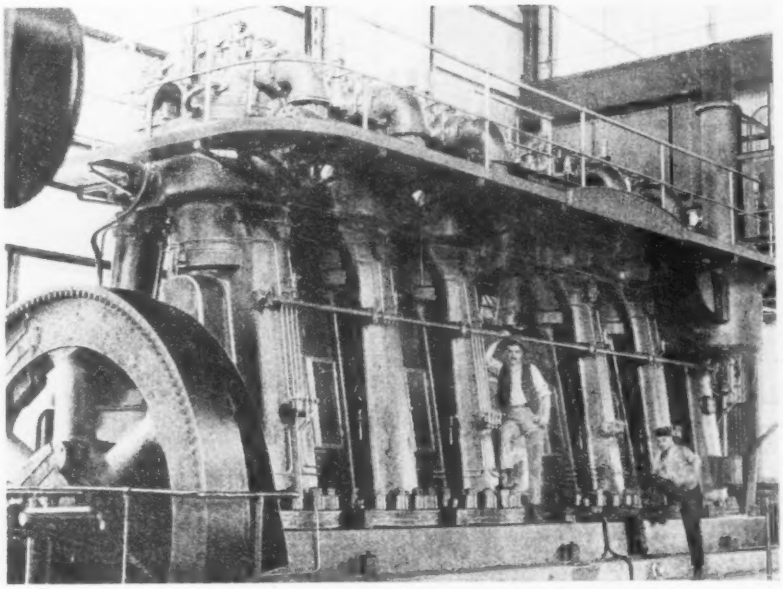
AGATHON STEELS

THE CENTRAL STEEL COMPANY, Massillon, Ohio

Swetland Bldg., Cleveland — Book Bldg., Detroit — Peoples Gas Bldg., Chicago
Aeolian Bldg., New York — University Block, Syracuse — Widener Bldg., Philadelphia
303 W. P. Story Bldg., Los Angeles, California

UMA-No 3 ALLOY STEEL

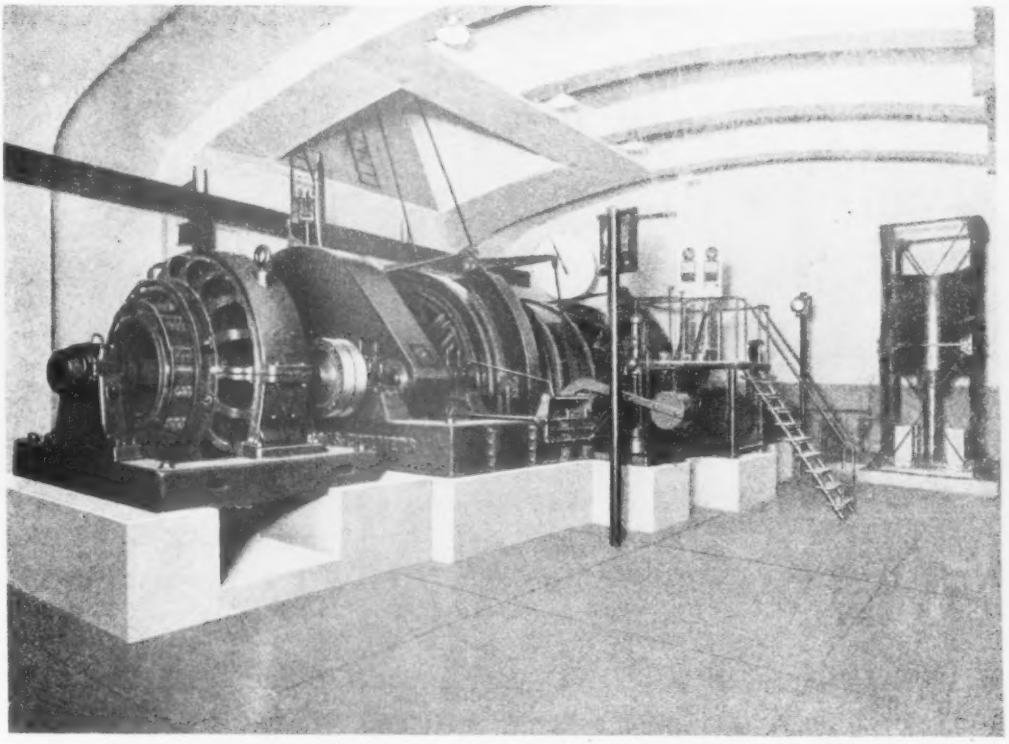
POWER



New Deisel Engine Plant of Old Dominion Copper Co.

POWER is a big item in the total cost of mining. Arizona Copper Companies have reduced power-cost to the minimum through the installation of the most modern equipment, thereby making their mines models in efficient production.

THE OLD DOMINION COPPER CO.



UNDERGROUND HOIST—UNITED VERDE COPPER COMPANY

United Verde Copper Company

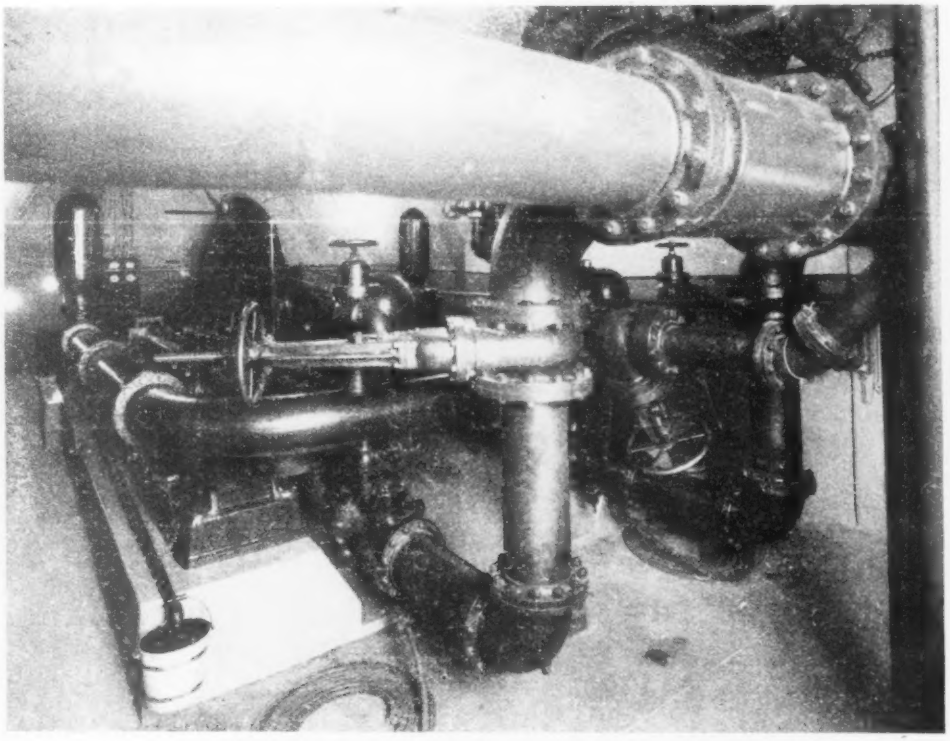
Where high costs yield to modern equipment. The hoisting problem simplified by powerful equipment supplied by Allis-Chalmers Company, Milwaukee, Wisconsin. This Hoist is located a mile in from the surface, on the horizontal, and 1,000 feet deep.

ARIZONA—A COPPER STATE

A FLOODED MINE!

THIS TRAGEDY DOES NOT FACE

The New Cornelia Copper Company



The above illustration shows the underground pumping station of the New Cornelia Copper Company, Ajo, Arizona, which is an indication of the modern efficient equipment installed at this property.

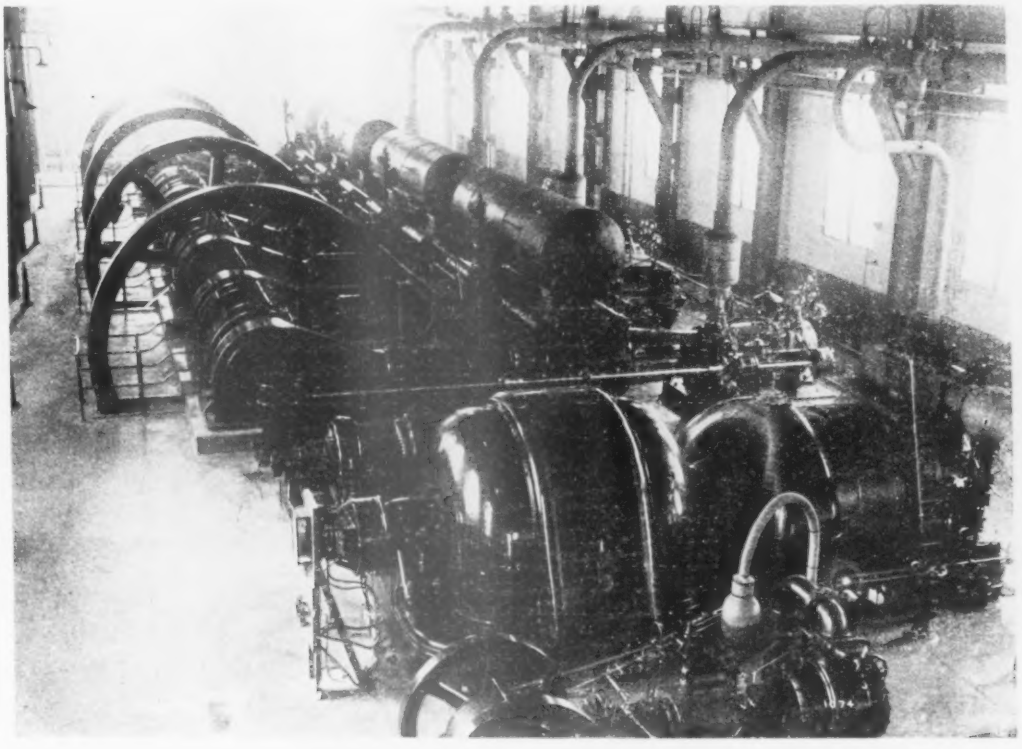
Through the use of EFFECTIVE EQUIPMENT

INSPIRATION CONSOLIDATED COPPER COMPANY

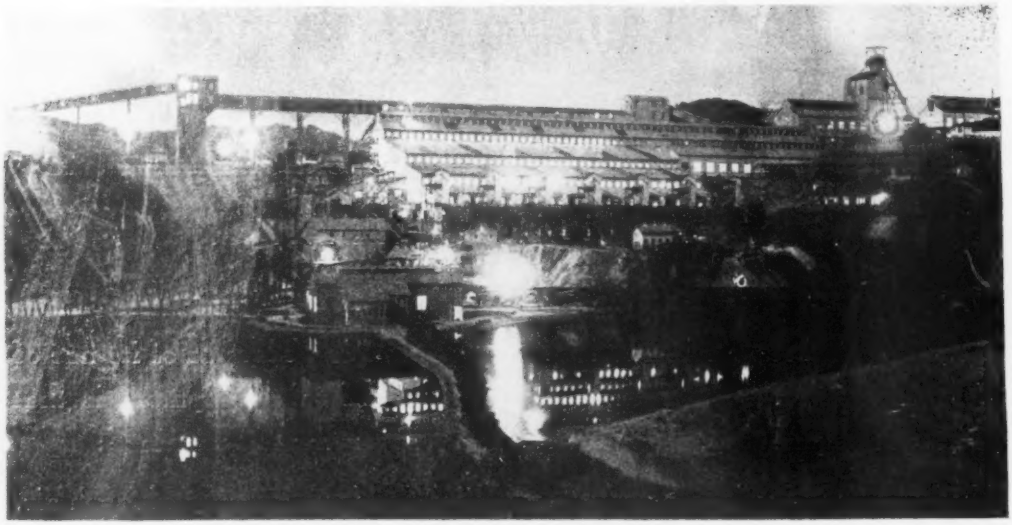
Has become a leader in efficient mine production because of its use of modern mechanical equipment. One phase of this equipment is that which produces fresh, clean air to the great depths of the mines:

Of vital necessity in all underground mining is the supply of fresh air. The Inspiration Copper Company's modern equipment provides adequately for this through their converter blowing engines.

Nordberg Converter Blowing Engine, Inspiration Consolidated Copper Co. and International Smelting Co. Power House



New York Office: 25 Broadway Mine: INSPIRATION, GILA COUNTY, ARIZONA



Photograph of the Mill of the Miami Copper Company Taken at Night

24 Hours Per Day

at the

Miami Copper Company

Miami, Arizona

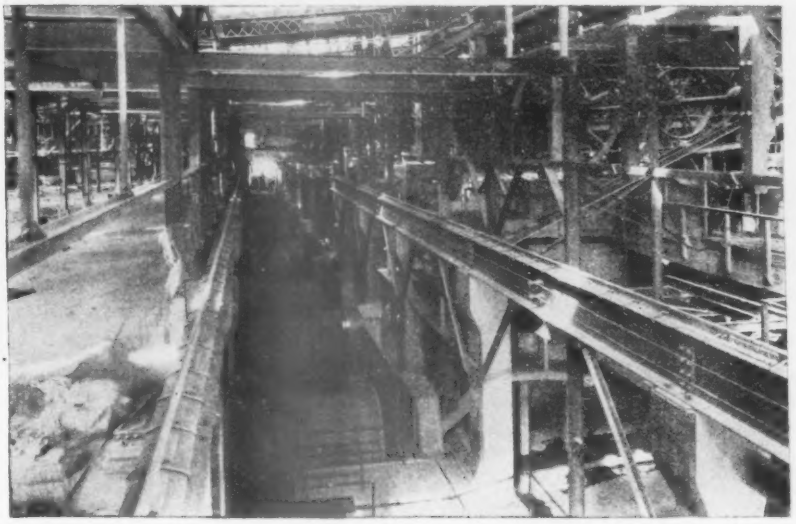
A Modern Mine, Mill and Smelter Efficiently Equippe throughout provides for continuous production and enables this company to market their product profitably in competition with other great copper producers.

ADOLPH LEWISOHN, *President*
J. PARKE CHANNING, *Vice-President*
SAM A. LEWISOHN, *Treasurer*
HERMAN COOK, *Secretary*
F. W. MACLENNAN, *General Manager*

New York Office
61 Broadway

Mine At
Miami, Arizona

Efficiency



Ball Mills at the Hayden Mill of the Ray Consolidated Copper Company

"The mills of the Gods grind slowly—
but they grind exceedingly well."

This battery of grinders illustrates the immensity of the operation in Modern Mining. **The application** of power through equipment is a vital factor in every mining plant. **They believe** in Modern, Efficient, Mechanical Equipment

at the

Ray Consolidated Copper Company

25 BROADWAY, NEW YORK

RAY ARIZONA

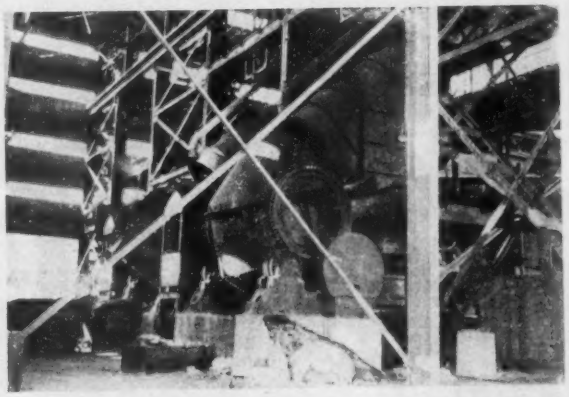
M—ine Management Simplified.
O—bsolete Methods Superseded.
D—elays Avoided.
E—fficiency Assured.
R—apid Handling of Materials.
N—ecessary Work Made Easy.

E—conomy in Production.
Q—uality of Product Increased.
U—nsatisfactory Conditions Eliminated.
I—njury Prevented.
P—ower Problems Decreased.
M—aintenance Costs Reduced.
E—ngineering Problems Simplified.
N—otable Achievement Made Possible.
T—roubles Relegated to a Machineless Age.

Has Made Possible

Low Production Costs

at the



Converters, Magma Copper Company, Superior, Arizona

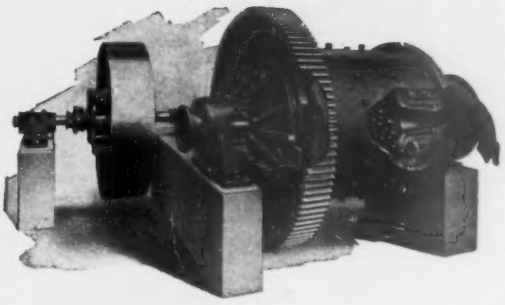
MAGMA COPPER COMPANY

Mines Located At
Superior, Pinal County, Arizona

President's Office:
14 Wall Street, New York City

XU

BALL GRANULATORS



DESIGNED by engineers who are familiar with the work for which the machine is intended—

PERFECTED by careful research experimentation and co-operation with our customers—

FURNISHED where continuous operation and economy are the first considerations—

FABRICATED with usual high-grade material and workmanship that characterize all ALLIS-CHALMERS products.

ALLIS-CHALMERS PRODUCTS
Electrical Machinery
Steam Turbines
Steam Engines
Gas and Oil Engines
Hydraulic Turbines
Crushing and Cement Machinery
Mining Machinery

ALLIS-CHALMERS MANUFACTURING COMPANY
MILWAUKEE, WISCONSIN, U.S.A.
District Offices in All Leading Cities.

ALLIS-CHALMERS PRODUCTS
Flour and Saw Mill Machinery
Power Transmission Machinery
Pumping Engines-Centrifugal Pumps
Steam and Electric Hoists
Air Compressors - Air Brakes
Agricultural Machinery
Condensers

PHELPS DODGE CORPORATION

99 John Street **New York**

CONCENTRATION PLANT, PHELPS DODGE CORPORATION, AT BISBEE, ARIZONA

"C ★ Q" Electrolytic **Copper** **"P. D. Co." Casting**

Helping the Copper Mining Industry

Through national advertising and other educational work, and through its Research and Building Service Departments, the Copper and Brass Research Association, 25 Broadway, New York, is helping to increase the sale and extend the uses of Copper and Copper products. If you are not in touch with this effort to help the copper mining industry we would be pleased to add your name to the Association's mailing list.

A chief purpose of the Copper and Brass Research Association is to co-operate with industry in the better use of copper and its alloys.

This advisory service entails no fee or obligation on the part of the inquiring manufacturer, but is directed toward helping manufacturer and consumer alike to cut down the huge waste caused by using metals which fail prematurely. An opportunity to help you will be welcomed.

LIST OF MEMBERS OF THE COPPER & BRASS RESEARCH ASSOCIATION

COPPER MINING COMPANIES

AMERICAN SMELTING & REFINING CO.
120 Broadway, New York
ANACONDA COPPER MINING COMPANY
25 Broadway, New York
ARIZONA COMMERCIAL MINING CO.
50 Congress St., Boston, Mass.
BRADEN COPPER COMPANY
120 Broadway, New York
CALUMET & ARIZONA MINING COMPANY
Calumet, Mich.
CALUMET & HECLA CONSOLIDATED COPPER CO.
12 Ashburton Pl., Boston, Mass.
CHILE EXPLORATION COMPANY
25 Broadway, New York
COPPER RANGE CO.
52 Broadway, N.w York
ENGELS COPPER MINING COMPANY
393 Mills Building, San Francisco, Cal.
THE GRANBY CONSOLIDATED MINING, SMELTING & POWER COMPANY, LTD.
25 Broad St., New York
GREENE CANANEA COPPER COMPANY
25 Broadway, New York
INSPIRATION CONSOLIDATED COPPER CO
25 Broadway, New York
ISLE ROYALE COPPER CO.
12 Ashburton Place, Boston, Mass.
KENNECOTT COPPER CORPORATION
120 Broadway, New York
MAGMA COPPER COMPANY
14 Wall St., New York
MIAMI COPPER COMPANY
61 Broadway, New York
MOTHER LODE COALITION MINES CO.
120 Broadway, New York
NEVADA CONSOLIDATED COPPER CO.
25 Broad St., New York
NEW CORNELIA COPPER COMPANY
Calumet, Mich.
OLD DOMINION COMPANY
50 Congress St., Boston, Mass.
PHELPS DODGE CORPORATION
99 John St., New York
RAY CONSOLIDATED COPPER COMPANY
25 Broad St., New York
SHATTUCK ARIZONA COPPER COMPANY
120 Broadway, New York
UNITED VERDE EXTENSION MINING CO.
233 Broadway, New York
UTAH COPPER COMPANY
25 Broad St., New York
WHITE PINE COPPER CO.
12 Ashburton Place, Boston, Mass.

COPPER and BRASS FABRICATING and DISTRIBUTING COMPANIES

THE AMERICAN BRASS COMPANY
General Offices, Waterbury, Conn.
AMERICAN SMELTING & REFINING CO.
120 Broadway, New York
ANACONDA COPPER MINING COMPANY
25 Broadway, New York
BRIDGEPORT BRASS COMPANY
East Main St., Bridgeport, Conn.
CHASE METAL WORKS
WATERBURY MANUFACTURING COMPANY
(Divisions of Chase Companies, Inc.)
Waterbury, Conn.
T. E. CONKLIN BRASS & COPPER CO., INC.
54 Lafayette St., New York
DALLAS BRASS & COPPER COMPANY
820 Orleans St., Chicago, Ill.
U. T. HUNGERFORD BRASS & COPPER CO.
80 Lafayette St., New York City
C. G. HUSSEY & CO.
2850 Second Ave., Pittsburgh, Pa.
MERCHANT & EVANS CO.
Washington Ave. and 21st St., Philadelphia, Pa.
MICHIGAN COPPER & BRASS CO.
Detroit, Mich.
THE NATIONAL BRASS & COPPER CO.
Lisbon, Ohio
NEW ENGLAND BRASS CO.
Park St., Taunton, Mass.
THE NEW HAVEN COPPER CO.
Seymour, Conn.
THE NEW JERSEY WIRE CLOTH CO.
Main Office, Trenton, N. J.
THE J. M. & L. A. OSBORN CO.
1541-51 East 38th St., Cleveland, Ohio
THE PAPER & TEXTILE MACHINERY CO.
Sandusky, Ohio
RICHARDS & CO., Inc.
Battery Wharf, Boston, Mass.
ROME BRASS & COPPER CO.
Dominick & Bouck Sts., Rome, N. Y.
SCOVILL MANUFACTURING CO.
Waterbury, Conn.
TAUNTON-NEW BEDFORD COPPER CO.
267 West Water St., Taunton, Mass.

Panorama of Hayden, Arizona, showing mill of Ray Consolidated

COPPER

The following paragraph is quoted from a book published in 1877 by H. C. Hodge:

> **"The mines of Arizona, varied and numberless, are no doubt the sources of the future wealth of the Territory and consist of gold, silver, lead, copper, coal, salt, and perhaps of other valuable minerals. These mines, especially those of precious metals and of copper and lead, are of wonderful extent and richness and are destined at no distant day to astonish the world by the immensity of their product."**

The mineral output of this state has run true to this prediction and continues to contribute heavily to the large mineral production figures of the United States.

Since 1910 Arizona has been the largest producer of copper in this country and since 1900 has produced over one-third of the total output.

During the period of 1854-1861, copper took an important stand; the successful working of the Ajo copper mines marked the birth of the copper mining industry in Arizona. The production at Morcenci began in 1873 and in 1880 Bisbee became an important producer.

At this time the ores of the old silver district at Globe became valuable chiefly for copper, and in 1887 production began at the United Verde mine.

Increase in production from the several districts continued each year and in 1911 the Ray Consolidated, in the Mineral Creek District, added its large output, followed in 1917 by the production of the New Cornelia mine in the Ajo district.

ARIZONA THE COPPER STATE

Copper Company and Smelter of the American Smelting and Refining Company

COPPER

Maximum copper production was reached by the Arizona mines in 1918 when 764,856,000 pounds of copper was produced. The output in 1924 was 672,365,115 pounds with a valuation of $87,407,465.

The industry, in 1919, employed 14,237 persons.

Among the important copper producing companies whose mines are located in Arizona, are:

Arizona Copper Company
Arizona Commercial Mining Co.
Arizona United Mining Co.
Calumet & Arizona Mining Co.
American Smelting & Refining Co.
Consolidated Arizona Smelting Co.
Inspiration Consolidated Copper Co.
Iron Cap Copper Co.
Magma Copper Company
Miami Copper Company
New Cornelia Copper Co.
Old Dominion Company
Phelps Dodge Corporation
Ray Consolidated Copper Co.
Shattuck-Arizona Copper Co.
United Verde Copper Co.
United Verde Extension Mining Co.

The managements of these companies are the hosts of the members of the Western Division of the American Mining Congress at Phoenix and Chandler, November 16th, 17th, 18th and 19th.

ARIZONA THE COPPER STATE

UNITED VERDE EXTENSION MINING COMPANY

Mines, JEROME, ARIZONA

Smelter, CLEMENCEAU, ARIZONA

Executive Offices
233 BROADWAY, NEW YORK

OFFICERS AND DIRECTORS

JAMES S. DOUGLAS, *President*.....Douglas, Arizona
LOUIS E. WHICHER, *Vice-President*.....New York
CHAS. P. SANDS, *Sec'y and Treasurer*.....New York
ARCHIBALD DOUGLAS, *General Counsel*.....New York
GEORGE KINGDON, *Gen'l Manager*.....Jerome, Arizona
PAUL ARMITAGE.....New York
ANDREW J. PICKRELL.....Los Angeles, Calif.
R. M. RAYMOND.....New York
ALEXANDER C. TENER.....Pittsburgh, Pa.

Ray Consolidated Copper Company

25 Broad Street
NEW YORK CITY

Ray Mines
RAY, ARIZONA

Chino Mines
HURLEY, NEW MEXICO

Utah Copper Company

25 Broad Street
NEW YORK CITY

Western Office
SALT LAKE CITY, UTAH

Nevada Consolidated Copper Company

25 Broad Street
NEW YORK CITY

Western Office
McGILL, NEVADA

How To Secure Better Blasting Results

Du Pont chemical engineers insure uniformity of quality by chemical control through every step of manufacture from raw material to finished product.

THE solution of blasting problems can be accomplished by adopting the methods proposed by the explosives experts composing the technical field staff of the du Pont Company.

Equipped with an extensive experience covering the selection and use of explosives, these expert "powder" men carry on their investigations in a thorough and efficient manner. The result is a practical and effective plan whereby the explosives required perform their work with a minimum expenditure of material, labor and time.

Put your powder problems up to du Pont—over 123 years of continuous activity in developing and making explosives for every requirement.

In ore mining operations use du Pont explosives

There is a du Pont explosive to meet every blasting need—to do *your* particular work *best* at *least* expense. For ore mining, we especially recommend:

Du Pont Gelatin Dynamite because it is plastic, absolutely waterproof, practically non-freezing and produces the smallest volume of obnoxious fumes. It is unequalled for underground shooting of hard rock.

Red Cross Ammonia Dynamite is ideal for its all-around blasting qualities and is the most popular high explosive sold. While it is classed as low-freezing, it is actually *non-freezing* under any atmospheric conditions.

Du Pont blasting accessories give you maximum efficiency from your explosives. Make every shot sure—protect your blasting investment by using only du Pont accessories.

For further information about du Pont explosives and blasting accessories, please refer to *Mining Catalog—Metal-Quarry Edition*—or write to our nearest office.

E. I. DU PONT DE NEMOURS & CO., Inc.
Explosives Department
WILMINGTON, DELAWARE

Branch Offices:

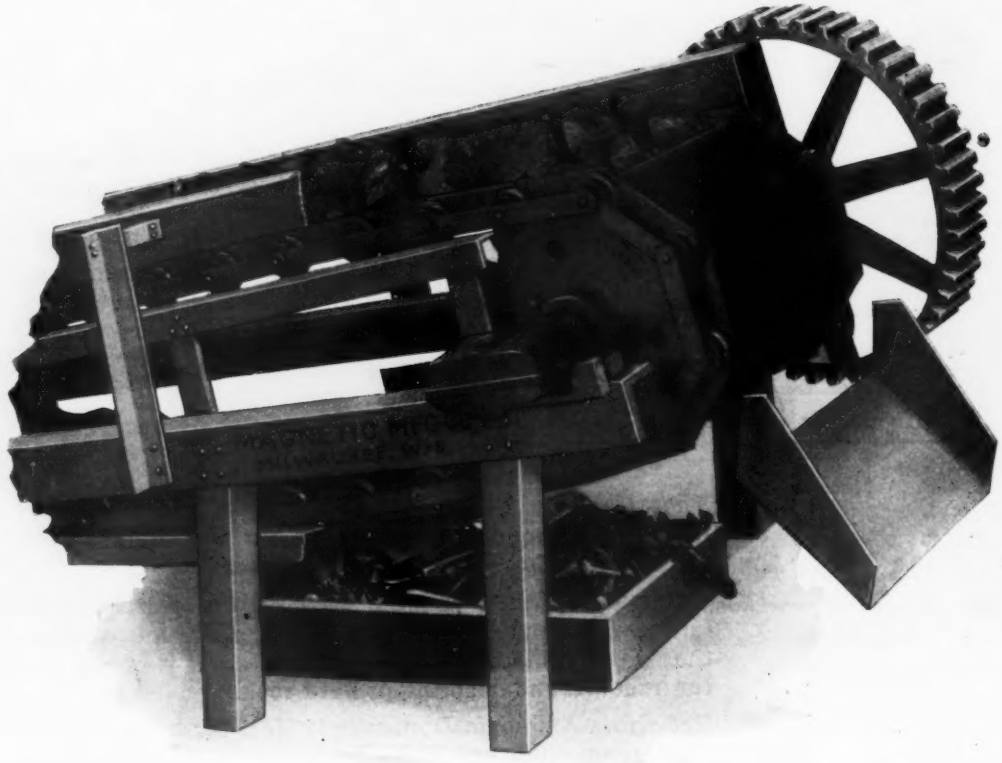
Birmingham . . Ala.
Boston . . . . Mass.
Buffalo . . . . N. Y.
Chicago . . . . Ill.
Denver . . . . Colo.
Duluth . . . . Minn.
El Paso . . . . Tex.
Huntington . W. Va.
Joplin . . . . . Mo.
Kansas City . . Mo.
Mexico City . . Mex.
Miami . . . . . Fla.
New York . . . N. Y.
Pittsburgh . . . Pa.
Portland . . . . Ore.
St. Louis . . . . Mo.
San Francisco, Calif.
Scranton . . . . Pa.
Seattle . . . . Wash.
Spokane . . . Wash.
Springfield . . . Ill.

Du Pont Products Exhibit, Atlantic City, N. J.

DU PONT

POWDER MAKERS SINCE 1802

"HIGH DUTY"
Magnetic Apron Pulleys



This device represents the greatest advance in twenty years in the act of Magnetic Separation.

DESIGNED by engineers who are familiar with the work for which the apparatus is intended.

FURNISHED where heavy service is demanded.

PERFECTED by careful research and cooperation with our customers.

ADAPTED to operate in apron conveyors or feeders of practically all makes.

FABRICATED with the usual high grade materials and care that characterize all Magnetic Mfg. Co.'s products.

OFFICES IN PRINCIPAL CITIES

HIGH DUTY Magnetic Separators

SEE TELEPHONE DIRECTORY

MAGNETIC MANUFACTURING CO.

203-205 TWENTY-FOURTH AVE. MILWAUKEE, WIS.

The MINING CONGRESS JOURNAL

PUBLISHED EACH MONTH BY
Subscription Rate: Per Year, $3.00

THE AMERICAN MINING CONGRESS

MUNSEY BLDG., WASHINGTON, D. C.
Single Copies: $0.30

VOLUME 11 NOVEMBER, 1925 NUMBER 11

NUISANCE TAXES

IN REVISING the Federal revenue laws, Congress should abolish the capital stock tax and the stamp tax on original issues of stock certificates and transfers of stock. The capital stock tax should be abolished because it is an uneconomic and unscientific method of raising revenue for the Federal Government, is justified only as a war measure, and is peculiarly oppressive and discriminative against the mining industry. The stamp tax should be repealed because, like the capital stock tax, it bears most heavily upon mining enterprises in the development stages.

The capital stock tax is levied annually whether profits are being earned or not. The stamp tax is levied at the inception of the corporate enterprise; and it is oppressive to the small mining corporation that is organized for the purpose of developing a mining prospect. In such cases the stamp tax at the beginning taxes a portion of the small capital contributed by the stockholders, and the capital stock tax takes a portion of the capital annually thereafter until the profit-earning stage is reached. In some instances small mine development companies have had to levy annual assessments on their stockholders to pay taxes and other expenses, including the Federal capital stock tax.

The repeal of the capital stock tax would afford a considerable measure of relief to the mining industry, since mining companies would be relieved of the expense of keeping different sets of accounts from which to make up returns and schedules on a calendar-year basis for income tax purposes and on a fiscal-year basis as of June 30 for capital stock tax purposes. And relief from the tax itself would be helpful.

Resolutions favoring the repeal of these taxes were unanimously adopted at the 27th Annual Convention of the American Mining Congress by delegates representing principally the gold and silver industries. Never before in the history of these industries have they been at such a low ebb, and in greater need of stimulation and relief from burdensome taxation. Congress has been cognizant of the condition of these industries. The Senate Commission on Gold and Silver Inquiry, after an exhaustive investigation, recommended, among other measures, relief from Federal taxes. The repeal of these war-time and nuisance taxes would be a step in the right direction.

NO BROKEN CONTRACT

THOSE who believe in fair dealing and the rigid observance of contracts—and that comprehend the decent element of society—were disposed to believe that Mr. John L. Lewis had the best of the argument in his statement at the rebirth of the northern West Virginia strike on September 26. Mr. Lewis said that he had signed a contract with the operators of that district at Baltimore under which they agreed to pay the Jacksonville scale. He said the district was not paying the scale. Therefore, he said that the contract had been broken. Instantly, this aroused the sympathy of the public. Everywhere, sober-thinking men were disposed, on this presentation of the case, to say that a serious matter was involved. They wondered why Mr. Lewis did not carry his complaint instantly to court and ask for specific performance under the contract or that the miners be awarded monetary damages.

The full disclosure of the truth in this matter indicates that Mr. Lewis did not go quite far enough in his statement of fact. The facts and figures are as follows:

The twelve counties comprising northern West Virginia had been, until 1918, wholly and unreservedly nonunion. This country was, at that time, at war. Many of the operators were in the service of the Government. We were engaged in a titanic struggle to get enough coal to keep our own army and our allies going. At that time, the miners threatened to strike in that field unless recognition of their union was granted. The operators conceded the point and the district became just as unreservedly a union field. This continued until the big strike of 1922, when the union took a stand which many of its members could not support—defied President Harding, who asked for arbitration. Starting with that date, the deflections from the union were pronounced. By the middle of 1923 this had become so pronounced that of the 395 mines in the 12 counties, 156 were nonunion and the remaining 239 still held to their union affiliations.

At the time of signing the Jacksonville scale, there was not enough business to keep all of the 395 mines in operation; instead, only 153 of them were producing any coal. Of that number of active mines, 79 were still affiliated with the union and signed the Baltimore agreement. The other 74 were nonunion and had nothing whatever to do with these agreements.

In the field at that time, there were 242 mines which were shut down and the owners of which took no part in the agreement. As those 242 mines resumed operations, they had the right to choose between the open shop or the closed shop contracts available in that field. Being no party to any agreement or conference and having been closed down for months, they were not bound by what any other operators in the field had done, especially as no agreement had given the members of the union a monopoly of the right to work in that field.

An important element in the situation is: A year previously, there had been 156 nonunion mines. Of these, only 74 were in operation at the effective date of the Jacksonville scale. Therefore, 82 nonunion mines were idle and could resume, in their original status, at any time they saw fit. Also, the whole district has not, for two years, had enough business to support, in action, more than 153 mines. Yet there were 156 mines which were nonunion. Thus the nonunion mines could easily have done all of the business available to the district.

The nonunion mines could and did charge a lower price for their coal. The union mines had to charge a high price. The market was, itself, low priced, for which reason the union mines were at a disadvantage. The result was inevitable, namely, the union mines gradually closed and the nonunion mines took the market. Thus, in January, this year, only 24 of the union mines remained in operation and 129 of the nonunion mines were doing the business. If the affiliations remained as they had been, this meant that 215 of the union mines and 25 of the nonunion mines were closed down.

It was this loss of business which Mr. Lewis, in his Fairmont speech on September 26, translated into a violation of the union contract. Two years before, his union had done 70 percent of the business of the district; at the rebirth of the old strike, it was doing 14 percent. Feeling the loss keenly, he said that the contract had been violated.

It is true that some men who had formerly worked under the union scale were, on the date of the rebirth of the strike, working under the nonunion scale. But they, themselves, had abandoned the union. They had done it in four different ways. They, as individuals, had surrendered their union cards; in groups represented by a chosen spokesman they had requested the rescinding of the union contract; by resolutions passed by local unions, they had rescinded the Baltimore contract; and, by petitions drawn by their attorneys, they had given notice that they requested a rescinding of the contract.

Nothing in this record supports the statement by Mr. Lewis that any contract has been broken in that field.

THE WAGES OF MINING

MINING is fast becoming a manufacturing industry. The extraction of minerals from low-grade deposits involves a process that places mining in a distinctly manufacturing class. Utilization of by-products is rapidly becoming an essential to prosperous mining enterprises, and the inventive genius of the age has made remarkable progress in this direction. It is both interesting and significant that upon coal rests the economic structure of 1,500 industries, all of which employ workers at the highest wage paid in the entire world. The fabricated industries growing out of the production of such minerals as copper, lead, zinc, gold, silver, and iron, truly are astounding.

The National Bureau of Economic Research has recently made an intensive study of wages and salaries in the United States, and has released its very interesting figures to the public. They show that in 1919, a year which they take as representative of conditions now existing, wages and salaries in the United States amounted to $34,800,000,000, or 58 percent of the total annual income. In 1909, $15,000,000,000 was paid in wages and salaries. While this Bureau does not segregate these wages according to general industry, the mining industry unquestionably is responsible for a large proportion of this payroll. And as mining processes develop; as new methods are found for the utilization of low-grade minerals; as new uses are found for minerals already known; as new minerals themselves are discovered, mining will share even more largely in the sphere of national employer.

The Government, both state and national, and the people of this country individually, will do well to foster and encourage mineral production, for largely upon the mining industry rests the economic importance of the United States. If legislators in the Sixty-ninth Congress will recognize mining in all its phases as a national asset and permit it to solve its own problems without political interference—or at least as an industry to be legislated for—not against—the predicted deluge of measures pertaining to mining will fail to materialize.

THE MINING HANDICAP

DEVELOPMENT of labor-saving machinery and the utilization of power have been of incalculable benefit to the mine worker. The adoption of labor-saving equipment has reduced the physical strain upon the individual miner, eliminated a large percentage of the accident hazard for him and increased his efficiency, thereby increasing materially the sum in his weekly pay envelope. But in spite of this, there is a natural tendency to object to mechanical equipment which displaces many laborers, even though it increases the wage of the individual. That natural tendency is a sufficient handicap without arousing and abetting it.

At the convention of the American Federation of Labor at Atlantic City, a resolution was presented, and adopted, which creates a policy on the part of that great organization of endorsing and advocating that "each increase in industrial production through the development of labor-saving machinery or water power shall be met by a corresponding increase in wages and shortening of the working day." Unfortunately the Federation in this instance was dominated by a few of its loose-thinking component parts.

It would seem that the growth of this country—an everlasting monument to the coordination of capital, brains and brawn—should be convincing proof of the wisdom of conservation of man-power, and that it should not now be necessary to present a brief in behalf of the adoption of labor-saving mechanical equipment in industry. Perhaps it is not so necessary in those industries that are not dominated by an organization whose published and oft reiterated slogan is "More pay and less work," or, "More men employed in industry and less production per man." But the mining industry unfortunately has that handicap.

The history of the production of minerals is comparatively short. But into it is woven the fiber of our industrial life. Without the adoption of labor-saving equipment, the United States would not now be the world power it is; and labor itself would still be in the dark ages. The present living standard of the American workman is based almost entirely upon industry's ability to produce in volume, and therefore cheaply. This standard is not sustained through the increased physical prowess of the individual worker, but through the inventive genius which enables that worker to produce, by machinery, many times his physical capacity. Such a resolution as that adopted at this convention is a direct blow at the workers' own bread basket.

The mining industry is thoroughly familiar with the type of mind that seeks to secure the endorsement of the Federation to such an uneconomic procedure. At every step in the introduction of labor-saving devices the operator and the manufacturer have encountered the opposition of the workers, through the United Mine Workers of America. The introduction of labor-saving equipment underground in the coal mining industry is of recent origin. And where this has finally been accomplished successfully it has been at a tremendous cost financially and frequently at the expense of peaceful industrial relations. The mine operator has long been convinced that his only salvation lies in the production of minerals mechanically. . Would the operation of the Utah Copper Company's property be possible with pick and shovel? True, it might have employed thousands of men at a *very small wage* and reached no where near its present economic importance, but through mechanical, labor-saving equipment it has developed an in-

dustry that reaches out far beyond the initial production of copper, giving employment to literally thousands of men—*at high wages.*

Labor-saving mechanical equipment has enabled the worker to possess those things that were the luxuries of the past generation. If labor is far-sighted, it will encourage its adoption.

RESEARCHING THE COAL INDUSTRY

AT intervals, some new individual stumbles upon the word "research" and decides, forthwith, that—with his own definition attached—it is the one word which fits the need of and should be applied vigorously to the affairs of the coal industry. Thereupon, we have a new spasm of interest along an old line, for a season, at least. All of this is a pity, because "research" is really a good word. It is a shame that so much foolishness is committed in its name.

When you come to realize it, quite a number of vital things about coal are known without any need for either search or research. For example, it is known that coal is a sort of a solid. It varies all the way from anthracite, which is quite solid, down to lignite, which is called a solid only because somebody is careless with his English. It is known also that this solid is violently torn from its resting place in the ground—often with far too much violence. In this operation, the miner, being a bit weary, shoots it off the solid. In the next phase, the people who want to sell it, handle it a great many times in order to present it to buyers in attractive sizes. In the process it is thrown from the pit car upon the screens; from one screen to another screen; from the screens into the railroad car; down another chute into a storage bin and is dug out of that bin by power-driven mechanism. It may have been a solid—some sort of a solid—in the beginning, but by the time it is ready for use it lacks the primary requisite of a solid, namely, form. What was once "coal" has become "slack."

Delving a little deeper into the store of common knowledge, we rediscover another familiar fact. Every trade paper which pays even passing attention to the market quotations, records at fixed intervals that the price of lump coal is, let's say, $3.00 a ton, and that the price of slack is, let's say, $1.25 a ton. From this simple statement of fact it becomes evident that the lump coal, for some reason, is more valuable than the slack. Indeed, we gather from the same trade papers that the selling price of the slack is somewhat less than the actual out-of-pocket cost of its production.

There is nothing to "research" in that situation. It serves no purpose to "discover" what everybody knows. The plain, obvious, open-faced fact is that the slack coal is a dead weight around the neck of the operator. Nor does it require a moment of "researching" to disclose the cause; that, also, is known. The fact is that as we increase the number of handlings of coal, we increase the percentage of slack recovered from each ton of mine run. There is nothing new about that; everybody knows it. Frequent handling and an increase yield of slack are inseparable; they are cause and effect. Every mine manager knows it and makes allowance for it.

Nor is it any discovery—much less something to be disclosed by employing highbrows—to say that the frequent handling was installed to increase the value of certain sizes and that the frequent handling reduces the mine realization by increasing the quantity of slack which must be sold at a loss. All of this is so obvious that even the clerks in the office at headquarters know all about it; certainly, the bookkeepers know it. A thing which is common knowledge does not have to be "researched" before it will be accepted. It is true whether it is "researched" or not.

The next fact is also commonly known. Of all the disasters which occur in coal mines, the most deadly are the "dust" explosions. An "explosion" is nothing more than the instantaneous burning of something. Coal is produced to be burned. So, the coal which will burn the quickest is, for power purposes, the best. Since coal is bought to be burned and since the fine coal will burn best, the slack should be far more valuable than the lump, which stubbornly resists burning. Therefore, rather than being sold for less than its cost of production the slack coal should be the most valuable.

The major difficulty seems to be to get equipment which will burn the fine coal easily and naturally. We were told the other day that one firm of patent attorneys, in Washington, has handled recently some 1,900 applications for improvements in the processes of treating this fine coal or slack. There, finally, we have found a subject for research. What are the principles underlying these applications for letters patent?

If someone wants to indulge in research—and can persuade someone to finance him in doing it—there is his subject. And, to save time, money, and labor, we suggest, gratis, that the Bureau of Patents is a storehouse of valuable information.

FAIR COMPROMISE

JAMES J. DAVIS, Secretary of Labor, in an address before the National Board of Jurisdictional Awards, makes an earnest plea to organized labor to submit its differences to an impartial board for decision, and urges it to continue at work until the decision of the board has been handed down and to then be men enough to abide by the decision.

Until labor, as well as capital, shall literally adopt such sound advice as that of the Labor Secretary, there can be no general peace in the industry.

Applying Mr. Davis' plan to the anthracite strike, its fairness to the worker, the operator and the consumer is at once obvious. The anthracite operators were and are willing to submit the entire controversy to an impartial board, but the head of the Miners' Union, with consummate arrogance, has flung their offer in their faces and insulted every clean-thinking citizen with the brazen statement that an impartial board of representatives of labor, of the coal producer and the general public would not be fair to *organized* labor.

Mr. Lewis, while in a sufficiently strong position to refuse arbitration because of the 100 percent unionism in the anthracite field, supplemented and strengthened as it is by the Pennsylvania certificate law, did not gain the approval of any part of the public by this attitude.

There is no law that can compel an individual to work unless he so wishes; but there is at least a moral obligation on the part of every citizen of these United States to play fair—to at least measure up to the standard of his opponent.

There may be some justice in Mr. Lewis' strike. It has not as yet been discovered, but surely a court of impartial arbitration would find it if it does, as the union believes and asserts, exist. It is sheer effrontery to say that a board of impartial men cannot be assembled.

Mr. Davis in his speech said, "So long as the trade union movement stands true to its principles and deserves support of its membership and of the public, just so long will it get that support."

Refusal to arbitrate is one way of losing at least the support of the public.

WESTERN DIVISION WORK COVERS CONSTRUCTIVE PROGRAM

Western Division Of American Mining Congress Is Clearing House For Metal Problems—Annual Meeting At Phoenix Offers Constructive Program—A Short Review Of Metal Problems Now Before The Division For Consideration

AT Grass Valley, California, last year the Western Division of the American Mining Congress adopted a definite and comprehensive program covering western problems. This program was presented to the twenty-seventh annual convention of that organization at Sacramento, Calif., last September. It was indorsed by the parent organization, and during the year just passed the Western Division has been busy in carrying out the plans outlined in that program.

Eleven states are represented in the Western Division, including Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, and Washington. Robert E. Tally, United Verde Copper Co., Jerome, Ariz., is the chairman of the division, and W. B. Gohring, Phoenix, Ariz., secretary. The following are the members of the Board of Governors of the division, the bylaws of which calls for two representatives from each state: Robert E. Tally, United Verde Copper Co., Jerome, Ariz.; W. B. Gohring, Phoenix, Ariz.; W. J. Loring, Los Angeles, Calif.; Robert I. Kerr, San Francisco, Calif.; George A. Stahl, Denver, Colo.; M. B. Tomblin, Denver, Colo.; A. P. Ramstedt, Wallace, Idaho; Ravenel Macbeth, Wallace, Idaho; Emmet D. Boyle, Mason, Nev.; Henry M. Rives, Reno, Nev.; John M. Sully, Hurley, N. Mex.; Joseph Woodbury, Silver City, N. Mex.; Robert M. Betts, Cornucopia, Oreg.; B. C. Yates, Lead, S. Dak.; V. S. Rood, Bingham, Utah; A. G. Mackenzie, Salt Lake City, Utah; Raymond Guyer, Spokane, Wash.

Robert E. Tally, Chairman of Western Division, American Mining Congress, General Manager United Verde Copper Company

It is with regret that the Western Division has to announce the death of one of its members, William F. Word, of Helena, Mont., who was the representative of that state on the Board of Governors.

Among the important subjects outlined at the Grass Valley meeting were (1) stabilization of the mining industry; (2) methods of attracting new capital to the mining industry, particularly in making known the West's undeveloped mineral resources; (3) modification of income tax law covering mineral discovery; (4) adoption of high-grading laws

F. W. Maclennan, Director, Arizona Chapter, General Manager, Miami Copper Company

T. O. McGrath, Director, Arizona Chapter, General Manager, Shattuck Denn Mining Company

P. G. Beckett, Director, Arizona Chapter, Vice-President and General Manager, Phelps Dodge Corporation

in all western states; (5) conservation of standing timbers in the mineral districts for mining purposes, to avoid long hauls of mine timbers; (6) creation of a Federal Department of Mines, with the formation of a State Department of Mines, to work in cooperation with it and

W. S. Boyd, Director, Arizona Chapter, General Manager, Ray Consolidated Copper Company

to coordinate state activities affecting the mineral industry. After this program was indorsed by the annual convention of the American Mining Congress, committees were formed to study these problems and to make recommen-

Louis S. Cates, President, American Mining Congress, Vice-President and General Manager, Utah Copper Company

dations to the annual meeting of the division, which this year will be held at Phoenix, Ariz., November 16 to 19, inclusive. The committees studying these various subjects will make their reports to this meeting and some of them will make definite recommendations as to how these problems may be solved.

While it will remain for the annual meeting at Phoenix to make definite recommendations concerning the work of this division for 1926, and while this meeting will adopt resolutions which will cover the activities of the division for the coming year, to be presented to the twenty-eighth annual convention of the American Mining Congress, to be held in Washington, D. C., December 9, 10, and 11, for approval, Chairman Tally, in a letter to the Board of Governors, recently outlined some of the more im-

T. H. O'Brien, Director, Arizona Chapter, General Manager, Inspiration Consolidated Copper Company

portant subjects which he felt that the division might well undertake in its 1926 program. These include taxation, freight rates, stabilization, industrial relations, standardization, research, and conservation. It will, therefore, be seen

W. G. McBride, Director, Arizona Chapter, General Manager, Old Dominion Company

C. M. Colvocoresses, Governor, Arizona Chapter, General Manager, Southwest Metals Company

Julius Kruttschnitt, Jr., Director, Arizona Chapter, American Smelting & Refining Company

George A. Stahl, Board of Governors, Western Division, Denver, Colo.

Bruce C. Yates, Board of Governors, Western Division, Lead, S. Dak.

W. J. Loring, Board of Governors, Western Division, Los Angeles, Calif.

that the chairman will ask the conference at Phoenix to include many new problems in the 1926 work. Mr. Tally's letter to the Board of Governors is as follows:

"In my opinion, the most important subjects to be considered are taxation, freight rates, stabilization, industrial relations, safety, standardization, research, and conservation.

"The Mining Congress, with its efficient organization and committees, has most of these matters well in hand and is rendering a wonderful service to the industry.

"With regard to the above-named subjects, I beg leave to offer the following comments:

TAXATION

"The methods of the Congress in handling this important subject are excellent and its accomplishments praiseworthy. I have, therefore, but little to offer in the way of constructive suggestion.

"Any attempt to remove or revise depletion or the discovery features should be vigorously opposed through the united efforts of the industry.

"We should strive vigorously for a method of valuing mines on a fair basis, important features to be considered being simplification, standardization, and permanency.

"A similar program for state purposes is, in my opinion, advisable, but I doubt if the various states, on account of their differing conditions, could agree at this time on a standard system.

John M. Sully, Board of Governors, Western Division, Hurley, N. Mex.

Emmet D. Boyle, Board of Governors, Western Division, Mason, Nev.

A. P. Ramstedt, Board of Governors, Western Division, Wallace, Idaho

FREIGHT RATES

"The Congress is also performing a splendid service in resisting all movements for a general increase in freight rates. It is cooperating to the fullest extent with the traffic representatives of the large mining companies, who are organized as a committee of the Congress, and to whom the industry is deeply indebted. All the Mining Congress chapters should organize traffic committees and actively assist the general committee. This subject warrants serious consideration and coordinated effort on the part of the entire industry.

Representative Group, Arizona Mining Men

STABILIZATION

"The most positive method of adjusting production to consumption is by collective curtailment, but apparently this is beyond the realm of possibility. To make this permissible would probably result in adding restrictions equivalent to government regulation, and this would bring about a condition even worse than that endured at present.

"Publication of production and consumption data will tend to show individual producers actual conditions, and this should impress upon them the seriousness of overproduction.

"Efforts to increase the uses for metals, to reduce costs, systematize marketing methods, and eliminate waste, will also tend toward stabilization.

INDUSTRIAL RELATIONS

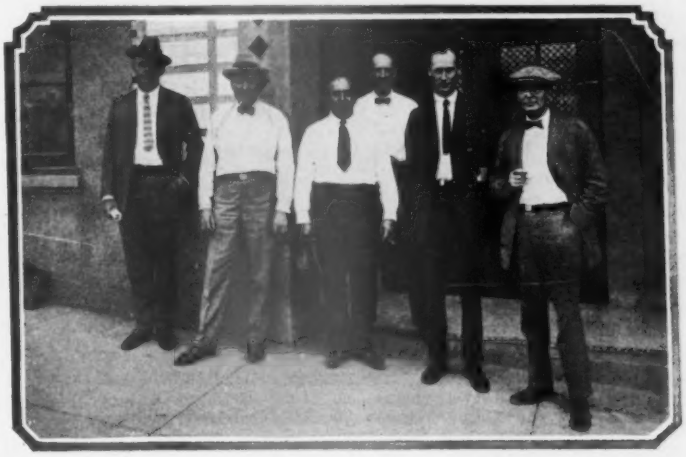
"This is one of our most important operating problems. On it depends the extent to which we may secure that cooperation of the employes which is essential to efficient operation.

"A great deal has been written on this subject. There are different methods of attaining satisfactory relations with employes and much time and money is being expended toward this end. Most employers appreciate the importance of treating their employes justly.

"However, it often occurs that the enthusiasm which the employer endeavors to instill in his men does not travel far beyond the organization heads, bosses, etc., the idea not being thoroughly sold to the main body of workmen. Therein lies the weakness of the system. An employer may have the best of intentions and his organization heads may be bubbling over with enthusiasm; but unless the workmen themselves are enthused, unless they know that they can depend on a square deal and have their grievance adjusted, the results will be disappointing.

"The same is true in regards to safety work and in general efficiency. Cooperation of the employes is needed. The department heads and bosses may be thoroughly sold on and enthused with the safety idea, but the problem is to sell the idea to the men—to get their cooperation.

"When shown the simple, practical way, workmen as a rule are glad to cooperate if they have confidence in their employer or boss. Confidence comes when the employe knows he will be treated justly in all ways and that he can depend on a square deal.



Group of Directors of the Arizona Chapter, American Mining Congress. Left to Right, P. G. Beckett, J. P. Hodgson, G. M. Colvocoresses, W. B. Gohring, T. O. McGrath and F. W. Maclennan

"Economy in the use of material, supplies, and labor, and the reduction of costs in general, requires the cooperation of all employes. It therefore seems to me that considerable time and effort can be directed toward securing the hearty cooperation of employes.

RESEARCH AND CONSERVATION

"Research work for the recovery and marketing of by-products now being wasted should be carried on continually, and the standardization of methods and equipment is a most important factor in increasing efficiency and reducing costs."

TAILINGS DAMAGE SUIT

Alleged damage to private lands by tailings and drainage from mine operations in Shoshone County, Idaho, are involved in a suit before the United States Supreme Court. The Bunker Hill & Sullivan Mining and Concentrating Co., Federal Mining & Smelting Co., Hecla Mining Company, and the Gold Hunter Mining & Smelting Co., have asked the court to reverse a decision of the Ninth Circuit Court of Appeals in favor of Jacob Polak. It is contended by the mining companies that the decision of the lower court deprives them of the reasonable use of the waters of the South Fork of the Couer d'Alene River for their mining and milling operations. The mining companies seek to set aside a judgment of the lower court for $36,575 in favor of Polak for damage to his lands and crops on account of overflow of flood waters of the river in December, 1917, and January, 1918, which are alledged to have carried poisonous tailings from the mining operations of the companies. The mining companies also ask the court to determine the right of the mining industry to the use of waters of public streams in their mining operations. It is declared that such right to use the waters in Idaho is guaranteed by the constitution of that state.

Main Shafts, Inspiration Consolidated Copper Company, Inspiration, Arizona

HISTORY OF THE DEVELOPMENT OF ARIZONA'S GREAT MINES

The End Of The War With Its Aftermath Of Huge Surplus Copper Stocks Was A Severe Blow To Copper Mining In Arizona—Production Now Reaching Normal—Early Day History, Present Activities And Future Possibilities Discussed In This Timely Article

By CHARLES F. WILLIS*

IN 1920 and 1921 the large Arizona mines were shut down due to a post-war condition of the copper mining industry. Since 1921 the mines of Arizona have built up their production to the point where, in 1925, it promises to exceed any other year in the history of the industry, even including the war years of 1916, 1917, and 1918, when production was under a forced draft.

Moreover, since the resumption of operations in 1921 the large mining companies of the Southwest have gone through a period of construction and reconstruction of a magnitude never before known in the history of the copper industry; this program covering practically all of the larger mines. It was the realization that it was necessary to modernize all equipment and get lower costs that has inspired the enormous construction program of the post-war period.

Arizona is primarily a copper state and, while it produces considerable quantities of the other metals and stands well up toward the top of the list in this production, they come largely as by-products of copper ores.

From 1845 to 1887 the State of Michigan was the leader of all of the states in copper production and in its total of 80 years of production has contributed to the copper resources of the world about 2,000,000 tons of the metal.

Copper Production In Arizona

Year	*Mil. lbs.*
1895	48.0
1896	72.9
1897	81.5
1898	111.2
1899	133.1
1900	118.3
1901	130.8
1902	119.9
1903	147.6
1904	191.6
1905	226.9
1906	262.6
1907	256.8
1908	289.5
1909	291.1
1910	297.2
1911	303.2
1912	359.3
1913	404.3
1914	382.4
1915	432.5
1916 (war year)	694.8
1917 (war year)	719.0
1918 (war year)	769.5
1919	531.8
1920	553.0
1921	155.2
1922	428.2
1923	618.9
1924	677.7

The leadership was taken away by Montana in 1887 and from that date to 1910 Montana was the leader. Yet in the 57 years of production Montana has produced only about 4,750,000 tons of the metal.

Arizona did not come into consequential production until the early 90's, after the leadership of Michigan. The production in Arizona grew rapidly and in 44 years of production has contributed about 5,500,000 tons of the metal and now produces annually an amount of copper practically equivalent to all other states of the United States put together.

The growth of the copper industry in Arizona is best shown by the figures on this page on copper production from 1895 to date, expressed in millions of pounds.

The mine production of gold, silver, copper, and lead in Arizona in 1924 amounted to $99,610,379 according to statistics compiled by Victor C. Heikes of the Bureau of Mines, Department of Commerce. The figures indicate a decrease of $4,690,821 from the 1923 output of these metals, which was placed at $104,301,200. The production of ore in 1924 was 19,820,505 short tons, as compared with 17,015,178 short tons re-

*Editor, Arizona Mining Journal.

General view of Miami Copper Company Plant. The new No. 5 Shaft to left of the mill and to the right the old No. 4, previously the main hoisting shaft

ported in 1923. The output of gold in Arizona in 1924 amounted to 235,995.74 fine ounces, as against 296,109.23 fine ounces in 1923. The silver output in 1924 is recorded as 6,649,276 fine ounces, as compared with 7,343,742 fine ounces in 1923. The recoverable copper in Arizona ores mined in 1924 was 677,752,013 pounds, as compared with the 1923 output of 618,928,602 pounds and the recoverable lead in ores mined in 1924 is placed at 18,642,314 pounds, as against 16,291,548 pounds for 1923.

While Michigan is famous as a copper state for its Calumet and Hecla mine, Montana stands high in the list because of the Anaconda and Utah has its enormous production from the Utah Copper Company steam shovel operations; Arizona gains its leadership from the fact that it has almost a score of large copper producers and even though but a few of them are comparable to Calumet and Hecla, Anaconda and Utah, the aggregate production brings Arizona to the top of the list by many millions of pounds of the metal.

The number of profitable producing mines is indicated by the dividend record. It is not possible to give exact totals due to the fact that during the early mining history of the state and territory the records were incomplete and inadequate, and there is no record of the many millions of dollars of dividends paid by such mines as the Congress, the Vulture, Tombstone, Silver Bell, and many other old timers.

Although the total for the state would be many millions in excess of the amount indicated below, the list of the recently active mines of Arizona, with their total dividends to January 1, 1924, is of interest.

This list does not include the dividends of the American Smelting & Refining Co., whose operations are pretty well scattered over the United States and Mexico, or the United States Smelting, Refining & Mining Co., who operate similarly. In addition to the above there are other mines in the same copper belt and close by the Arizona border, and their dividend record might well be included in the record. Among these mines are Chino Copper, $29,991,709; Greene-Cananea, $23,581,179. The dividend record for Arizona for 1924 totaled $11,969,155.

A List of Recently Active Mines of Arizona With Total Dividends Up to January 1, 1924

Arizona Commercial	$1,219,000
Arizona Copper	22,263,165
Arizona Copper, pfd	2,605,049
Arizona United	100,000
Calumet and Arizona	50,499,409
Golconda	170,000
Inspiration	40,756,651
Iron Cap	1,053,207
Magma Copper	1,704,000
Miami Copper	27,433,343
New Cornelia	4,500,000
Old Dominion	14,405,260
Old Dominion M. & Sm.	8,424,000
Phelps Dodge	103,050,000
Ray Consolidated	25,412,620
Shannon	1,425,000
Shattuck-Arizona	7,612,500
Southwest Metals	498,900
Superior & Pittsburgh	10,318,569
Tom Reed	2,755,350
United Eastern	5,997,200
United Globe	4,255,000
United Verde	72,412,500
United Verde Extension	19,267,500
Warrior Copper, pfd	47,600
Wolverine & Arizona	83,079
Total	$428,068,902

Early Day Development

While the early day history is of interest, the industrial development of Arizona in a larger way and on a permanent basis did not start until the country was reasonably safe from the Apaches and the well rounded development came with the advent of the railroads, although the inspiration for the railroad building came from the developing mines.

The mines can claim no credit for having any part in the building of the two transcontinental lines, the Southern Pacific and Santa Fe. They merely crossed Arizona because it was in the road between the east and California, but since that time all railroad building, except one short line, has been dependent upon the mining industry.

The Congress, Poland, Crown King, Clara Consolidated and other mines brought the Santa Fe, Prescott and Phoenix south from Ash Fork. The United Verde brought a railroad into Jerome, and, on the building of its smelter at Clarkdale, brought another into

that town, which was later lengthened by the United Verde Extension.

The Ray Consolidated, Christmas and Superior properties built the Arizona Eastern from Phoenix, and the Commonwealth mine at Pearce enticed it south from Cochise. The Old Dominion inspired the G. V. G. and N. (now Southern Pacific), and the Miami and Inspiration properties lengthened it.

The Phelps Dodge properties brought the El Paso and Southwestern lines and its feeders to Tombstone, Courtland and other points. The Patagonia mines brought branches south from Senson and Tucson. The Imperial mine coaxed a road through south from Red Rock and the New Cornelia found the Tucson, Gila Bend and Ajo line a necessity.

The mines at Clifton called the Arizona and New Mexico into being and the connecting narrow-gage would never have been built if it had not been for the mines at Morenci. The Magma has built a branch from the Arizona Eastern to Superior and the Mascot and Western line connects the Central Copper property with Willcox. Mines built every one of them.

With the exception of Flagstaff, Winslow, Yuma and a part of Tucson, every populous town in the state came into being responsive to the mines and the railroads they built. There is one purely agricultural railroad in the state, the line from Phoenix to Buckeye, which was only built from a bonus and never has returned a dividend.

To make any attempt to record the history of the present day copper mining industry in Arizona would practically necessitate a story on each of the larger districts, the usual story of success after many failures, the troubles with financing, the metallurgical and mining difficulties. All of these represent a well known tale common to mining anywhere. Arizona development has largely followed the progress of the development of copper mining and metallurgy and has been the field of much of the metallurgical development of that metal.

One might well record the fact that the Arizona Copper Company was the first of the porphyry coppers, a classification in the field of copper mining that figures so largely today. The farsightedness of the Calumet and Arizona in developing a mine where no surface showing existed in spite of widespread protest against the wisdom of their venture and the good faith of their backers is a story in itself.

Copper Queen

The trials and tribulations of Dr. James Douglas in getting the Copper Queen on a producing basis is a most interesting story which has been told by Dr. Douglas himself. Very few mines have a more interesting history than the Copper Queen of Bisbee, in Cochise County. Little did the early day prospector realize what fabulous fortunes lay under his feet while searching for gold in the then undeveloped copper districts of Arizona. In fact, in those days the gold prospector was prone to shy at anything that did not give him immediate promise of yielding a fortune in gold and silver.

Concentrator of the Phelps Dodge Corporation at Bisbee, Ariz.

An interesting incident of this kind occurred in connection with the early history of the ground now owned by the Copper Queen, one of the world's foremost copper producers, and which has paid over $103,000,000 in dividends. The original claims of the company were located by Hugh Jones, who surrendered his location in disgust because it showed nothing but "copper stain." He was looking for silver.

Later, George Warren, with a party of prospectors, entered the mountains and relocated, on shares, Jones' Copper Queen claim, and did considerable work. Evidently Warren did not have any higher estimation of the worth of the property than its previous owners, for he bet his interests in the one Copper Queen on a foot race and lost. It has been figured that Warren's interest gambled away on a foot race has since paid $13,000,000 in dividends.

Inspiration

The mathematical building of a mine on very low grade ore and on volume production is the interesting story that would come out of a study of the work of the Inspiration mine, thus pointing the way for others to profitably work ore with small copper content. The devising of a method for cheap mining, low cost handling, the inventing of a process for the economical extraction of copper metal from mixed sulphide and oxide ores, etc., are but a few of the many problems faced and solved.

Magma

The property of the Magma Copper Company is of more than passing interest, as it is also of historic interest, being one of the earliest locations in the state. It was located along about 1875, about the same time that the historic Silver King was discovered, and was, at that time, known as the Silver Queen. It does not have the record of early day production of silver that the Silver King, with its 13 years of active operation, following its location in 1875, has, although it was located for silver; but it never was as extensively worked.

Its early day operations were full of historic anecdotes of Indians, Apache raids, etc., and one of the most interesting of the Indian stories of territorial Arizona is centered around the incidents that gave the names to two local landmarks, Sentinel Peaks and the Apache Leap.

Miami Copper

Although the history of Globe district dates to the pioneer days of Arizona, within six miles of Globe were low red iron-stained hills that gave but slight evidence on the surface that they contained copper in paying quantities. To be sure, stains were found in various places, but stains were not considered as sufficient indications of values. There was no precedent for commercial ore being present under this red capping, but on the basis of the copper stains "Black Jack Newman," "Jim" Falls, J. P. Oates and others located the ground that is now owned by the Miami Copper Company. It was all new to them but they held on with the intense optimism of the prospector and maintained their assessment work.

New Cornelia

A large area of green-stained, very low-grade ore on the surface and nothing else in its favor were the conditions that confronted the first locators of the property of the New Cornelia Copper Company in 1853. Everything was wrong, the ore was not high enough grade for direct smelting, moreover, it was highly siliceous, the section was the driest God ever made, and there was no chance of water within many miles. Transportation was quite distant and the deposit did not seem to be of a grade to justify building a railroad to the property, but as improved methods of treating low-grade ores were perfected, the present company took hold of it and started in to scientifically solve each one of the difficulties that seemed to be in evidence.

The large body of ore was attractive, and all that seemed to be lacking to make it a great dividend payer was the application of scientific and modern methods of development of the ores and their treatment. Colonel Greenway and associates of the Calumet & Arizona Co. believed there were great possibilities for the New Cornelia ore body, and having at their command the necessary engineering ability, as well as being in a position to command the capital, they proceeded to acquire the property, which has been brought to a stage of development where the record of the property to date, in point of production, has vindicated the faith of its sponsors.

Old Dominion

Starting operations before the railroads had penetrated Arizona, and when the territory's chief inhabitants were roving bands of wild Indians, the Old Dominion mine has a record she justly can be proud of, having developed from a copper-stained outcrop into one of the most important producers of copper in the United States, and on the once barren hills flanking Pinal Creek there has been reared one of the most populous and prosperous mining cities of the great Southwest.

Soon after the close of the Civil War, those hardy pioneers of civilization, the prospectors, began venturing into Arizona in ever increasing numbers, but their explorations were restricted for many years by the dangers from the Indians who then infested the territory. There were more adventurous spirits, however, that could be daunted by no dangers, however great the peril, and for whom the wilderness of mountains and desert plains held no terror.

Among these was a band of prospectors who left the little settlement of Florence to explore the unknown mountains to the east. Crossing Pinal range they finally reached the banks of Pinal Creek near what is now the City of Globe, and discovered a large iron and copper-stained outcrop on which they located the Globe claim, whence the city takes its name, and which is now a part of the Old Dominion mine. On their way back from Florence they located the Silver King mine, which afterward became so famous for its rich silver ore.

Ray Consolidated

The early history of the Ray Consolidated was beset with failures and the story of the success of Ray Consolidated might well be written around the theme of the importance of organization in mine building for it required smoothness of operation and organization before Ray became a profitable producer.

Phelps Dodge Operations at Sacramento Hill, Bisbee, Ariz.

The copper mine of the Ray Consolidated Copper Company has the reputation of being the largest "porphyry copper" in point of mineralized area in the Southwest. Within its 180 acres of thoroughly prospected and developed ground there are 80,000,000 tons of ore reserves averaging 2.17 percent copper, equivalent to an average of almost 500,000 tons per acre. All told, about 580 acres have been proven mineralized.

Shattuck-Denn

The Shattuck Arizona Mining Company is possessed of one of the most wonderful mines in the state for several reasons. It is a little mine but rich—wonderful scenic effects are produced by its caves, and it contains a larger variety of minerals and produces commercially more different minerals than any other mine in the state. It is the "Biggest Little Mine." It is little only in the extent of its surface area, but big in every other way.

United Eastern

In a state that is so internationally known for its copper mines, it is usually thought that nothing but copper mines exist and that no gold and silver is produced except that produced with the ores of copper, and hence the story of the United Eastern Mining Company, one of the largest dividend-paying gold mines in the United States, seems rather out of place in the operations of large magnitude that usually mark Arizona copper operations. Yet no review of Arizona mining would be complete without some mention of the mine that has paid almost $4,000,000 dividends since 1917, a rather remarkable record for a gold mine.

The discovery of the United Eastern mine reads like a romance. In March, 1913, J. L. McIver, a miner and a man of keen observation, came into the Gold Road-Tom Reed district looking for a "poor man's opening" in mining. He found two of these that suited him. One was a lease on the Old Moss mine, and the other was an option on the group of claims now included in the United Eastern property.

The principal merit of the latter was its proximity to the ore shoots of the Tom Reed mine. After securing these options, McIver sent to Bisbee for his partner, George W. Long, and these two proceeded to work on their lease, and at the same time tried to raise funds for the United Eastern property. With absolute faith in the enterprise, they did what work they could by themselves, and even went to work for wages in the adjacent Tom Reed mine to raise additional funds. Their observation in this mine confirmed their faith in their optioned property, and they approached several capitalists for financial assistance. All was rosy from then on.

Tom Reed

The history of any mine makes interesting reading, and the story of most mines would make good, romantic pictures, that even the most practical of us would enjoy. The Tom Reed, another of the dividend paying gold mines, is no exception to this statement.

The old original group of claims had been "turned down" by so many engineers and the property had reverted

back to the old owners so many times, that the owners themselves were about convinced that it might be good business to allow Uncle Sam to again become the owner. The present owners purchased the property at a sheriff's sale, and it paid almost three millions in dividends.

United Verde

Probably no mine in the country has suffered more from "fables" than has the United Verde Copper Company, owned almost entirely by Senator W. A. Clark. Its richness, its large dividend record, its immense glory hole, and many other factors have made many imaginative tales as to its beginning and many fabrications as to its richness, but it was not without its difficulties.

United Verde began its career as a gold-silver producer in 1880, when its location was made. Pioneer prospectors from the then active Bradshaw mountains gold-silver country made the location. Prospectors from other gold-silver mining sections of Yavapai County were then attracted, and a considerable number of locations were made in the vicinity of United Verde, which has ever since been a lode stone with large powers of attractions for the prospector, but small returns, except in the case of the United Verde.

The latter property operated at a loss as a gold-silver mine between 1883 and 1885. It was practically idle and an abandoned hope from 1885 until 1888, when Senator Clark followed strong recommendations of the property for its copper values and his own good mining judgment, and bought the 13 claims upon which the original company had been organized, along with some adjacent properties.

He secured the Verde at a very low price, measured by its subsequent achievements, but which at the time was considered a very good bargain by those disposing of it. Senator Clark set about developing it for copper values, and after considerable expenditures found that his judgment had been correct. Since then he has made it one of the great copper mines of the world.

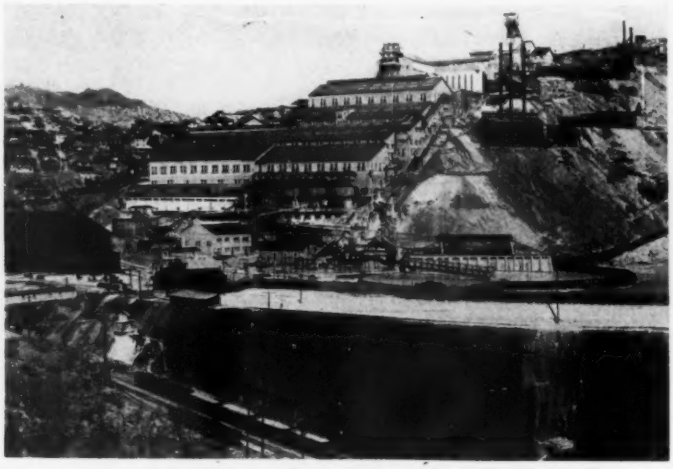
It was after 12 years of operation that its first dividend was paid and that was 25 cents per share per quarter, but since that time it has more than made up for lost time. Over $72,000,000 has been distributed in dividends.

Innumerable other stories might be told, picturesque, interesting, instructive and entertaining but voluminous. However, a brief recital of the activities of the present day among the mines of Arizona is in order. While the recital on each may be brief, there are so many mines to write about that the total is great.

POST-WAR ACTIVITIES

Gila County

In working out any resume of the activities of the mining districts of the Southwest, the place of honor must be given as usual to Gila County, and within Gila County the leader in progress has been the Inspiration Consolidated Copper Company. With this company it has been a period of many million-dollar projects, in spite of the fact that the company has been producing copper at only a rate of 7,500,000 pounds monthly, whereas its capacity is considerably beyond that point.



Concentrator of the Morenci Branch, Phelps Dodge Corporation

The porphyry shaft, one of the largest shafts in the world, was completed by the Inspiration Consolidated and hoisting started in November, 1924. The tonnage started at 1,000 tons daily and will be gradually increased until 10,000 tons daily will be handled through that shaft. It is one of the most modern and completed shaft installations found anywhere in the world.

The increasing need of cheaper power for the handling of lower-grade ores and the ample market provided for power with the mining industry caused a contract to be made recently with the Salt River Valley Water Users' Association whereby the Inspiration Consolidated Copper Company agreed to purchase practically the entire output of the proposed new dam, the Horse Mesa Dam, at a price which would entirely repay to the water users' association the cost of construction of the dam and the necessary carrying and operating charges.

This contract has been a splendid piece of cooperation between the agricultural and the mining industries, for the agricultural industry needs the water and the mining industry needs the power. The adequate power market permitted the sale of the bonds at a good price which would probably not have been possible if the dam had been erected solely for irrigation purposes. Incidentally the construction of the Horse Mesa Dam has caused one of the largest orders for electrical equipment which has ever been placed in the southwest, aggregating about $1,000,000 and placed recently with the General Electric Company.

The cheaper cost of power provided by hydro-electrical development has permitted the starting of construction of a 7,500-ton leaching plant for the handling of mixed oxide and sulphide ores by the Inspiration Consolidated Copper Company. This is a $6,000,000 project which will take several years to complete and which, when completed, will be the first plant erected for the purpose of handling a hitherto unsolved metallurgical problem, the result of five years' experimental work by expert metallurgists employed by Inspiration for the purpose.

To a certain extent it starts a new era in copper metallurgy, for the satisfactory handling of mixed oxides and sulphides will make available millions of tons of low-grade ore that have not been considered heretofore as commercial.

The Miami Copper Company has practically completed a $1,000,000 improvement program designed for the purpose of increasing their tonnage to 10,000 tons daily and to simplify their milling process for the handling of lower grade ores.

For year in and year out operation, production, and dividends, the Miami Copper Company holds the prize. When others have shut down or curtailed, the Miami Copper Company has maintained its production at about 6,000,000 pounds a month and maintained its dividend rate. While the ores of Miami Copper are low grade ores, it has been known for some time past that the ores of the grades which it has been working have been nearing exhaustion and during the latter part of 1924 a $1,000,000-program of improvements was started, increasing the capacity of its plants from 6,000 tons daily to 10,000 tons daily and pro-

viding for the handling of lower grade ores than previously considered commercial.

Of the lower grade ores not previously considered profitable, the Miami Copper Company is reported to have about 36,000,000 tons available, an ample supply for many years production and with the improvements made, the Miami Copper Company starts again on a long era of production without the fear of stopping because of the exhaustion of ore reserves.

The old-timer of Gila County, the Old Dominion Company, has been operating at about 80 percent capacity, producing about 2,500,000 pounds of copper monthly with a possibility at somewhat better than 3,000,000 pounds. The improvements of the past year made by the Old Dominion have been internal and the work with selective flotation has so far permitted of the elimination of pyrites from its concentrates that it was no longer necessary or advisable to maintain its own smelter for the handling of its particular ores, and on November 30, 1924, the Old Dominion smelter closed and the ores of the Old Dominion were diverted to the International smelter, which handles practically all of the ores of the Globe-Miami district.

Encouraged by the recent advances in the price of copper and the better outlook for the industry, the Old Dominion Company is about to start upon a program of enlargement and improvements which will provide a greater capacity. The most important feature of this program is the enlargement of the concentrator by the addition of another unit which will increase the milling capacity from 1,300 to 1,500 tons daily. The cost of this new unit will be about $140,000.

Water has always been a problem at the Old Dominion and included in the program about to be started is a new pumping plant on the 2,000 level for the lifting of water from the 2,000 to the 1,200 foot level. These pumps are to be quintuple plunger pumps, each of 1,000 gallons capacity driven by electric motors through speed reducing gears.

In the Copper Hill section the Arizona Commercial Mining Company is now producing copper at its lowest cost in the company history, about 9 cents before depreciation and depletion. The company is producing about 700,000 pounds of copper, or about 200,000 pounds less than its capacity. This company has continued sinking, and the Copper Hill shaft has now been sunk to the 2,200 level.

The Iron Cap Copper Company recently closed its mill and reduced its mine force approximately 25 percent. The reason for the mill closing was stated by General Manager F. A. Woodward that "it could not be operated at a profit upon the limited amount of milling ore now daily available. The company is continuing, however, to mine smelting ore and making shipments direct to the International smelter at Miami and are also making arrangements for an intensive development program to provide additional milling ore reserves."

The Superior and Boston Copper Company, which is the largest silver producer of the Globe-Miami district, has concentrated its production upon its silver and rather neglected its copper because the price of silver made possible a profit which copper did not offer.

There has been some stimulation to the asbestos industry by the recent contract of the Asbestos Company, Ltd., of New York, which purchased the entire output from the San Carlos Company. Gila County offers considerable possibilities for the production of asbestos, and the difficulty in the past has been the marketing.

Among the development projects of Gila County which deserve a particular mention are those of the Pinto Valley Company and the Mineral Basin Copper Company. The Pinto Valley Company was a merger of the Arizona National, the Cactus, Castle Dome and Pinto Copper, located close in to the big porphyry coppers, with similar surface showings, and prospecting by drilling has given evidence of the possibility of another large porphyry copper. The Mineral Basin Copper Company, which is located between Globe and Ray, has started a constructive development and prospecting program on ground favorably located and with good surface showings.

Mohave Loses Two Producers

The feature of the past year in Mohave County has been the stopping of company operations at the United Eastern Mining Company and the Tom Reed Gold Mines Company at Oatman, due to the exhaustion of their gold ore reserves. Both of these companies shut down about a year ago, the United Eastern stopping all operations and devoting its activities toward the finding of additional properties, and the Tom Reed changing from company operation to leasing system, handling ore in its mill from some of its own property and some other near-by development projects. The mill of the Tom Reed Gold Mines Company has been handling about 75 tons daily from the various leases.

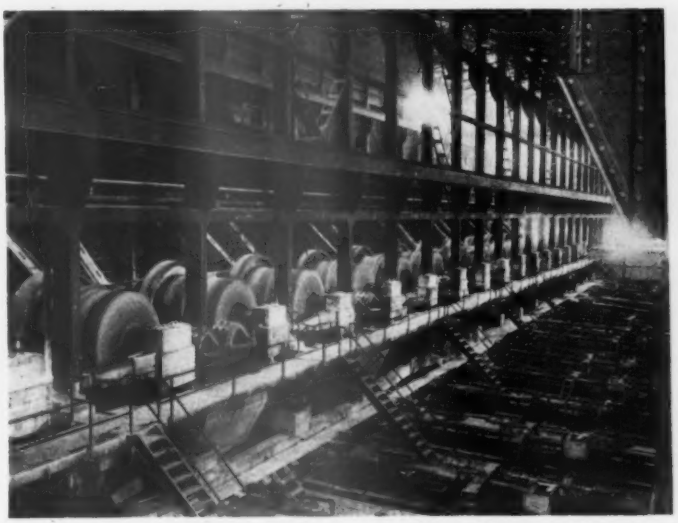
The United Eastern Mining Company has undertaken the development of the Barbara property, near Mayer, Ariz. Work has not yet proceeded on that property sufficient to determine as to whether they are going to make a mine of it or not. However, the indications are considered favorable.

The Katherine Mines Company have completed the construction of their milling plant and this plant is now handling approximately 80 tons daily and improvements are being made that will make possible the increasing of this tonnage.

The Oatman United Gold Mining Company has completed the construction of a mill with 75 tons capacity, using the Sill & Sill electro-cyanide process and has considerably bettered the development of its properties, making underground connections with the properties of the Oatman Gold Mining Company.

The Telluride Mining Company has also completed mill construction, a plant of 60 tons capacity, and has been operating at about 35 tons daily, running on $20 ore.

Work has been continued at the property of the Goldroad Mining Company, owned by the United States Smelting, Refining & Mining Company, and it is reported to be producing more gold bullion than at any time in its history. The work at the Goldroad Mining Company property has been productive of



Ball Mills and Flotation, Inspiration Consolidated Copper Company

several rich ore strikes and some new and encouraging developments on its 300 level.

Mohave County is a section of numerous small operations and producers and probably the biggest recent advance has been the establishment of the Kingman sampler by the Western Ore Purchasing Company, built to handle about 100 tons daily. This was started in October, 1924, and it has given the opportunity to the many mines of this section to handle small quantities of ore and receive pay for certain metals contained that would have been penalized if sent direct to a smelter.

The opening of the sampler has been largely responsible for the activity of the county and the operation of many of the smaller mines. There has been considerable development and construction work at the United Western mines, which were reorganized during the year, the United American, the United Republic, the Gold Dust Mining Company, the Dean Mining Company, the Kaaba Mining Company, the Paymaster, the Gold Gulch Placers Silver Creek Bonanza and the North Star Development & Mining Co., and many others.

Magma Improves Pinal County

The blowing in of the new smelter and the completion of the Magma's $4,000,000 construction program in March, 1924, served to greatly increase the production of Pinal County. This program involved smelter construction, a standard gauge railroad and mill remodeling. Since that time Magma has been running at practically capacity, somewhat over 2,500,000 pounds monthly, and the new construction program has been amply justified by the reduced costs of operation, which are now reported to be about 6.79 cents per pound of copper. Among the construction activities of the company during the past year has been the completion of a dam for water storage for the smelter, providing for the maintaining of a supply of 1,250,000 gallons.

Magma continues to be a mine of exceptional strikes and during the past year some wonderful ore has been encountered on the 600-foot level running 48 percent copper, 52 ounces silver and $2.50 in gold. With the end of 1924 came the retirement of W. C. Browning, who has placed the Magma Copper Company among the profitable producers of the southwest, and the appointment in his place of William Koerner as general manager.

Part of Plant of Ray Consolidated Copper Company, Ray, Ariz.

Work on a comprehensive remodeling of the milling plant of the Ray Consolidated Copper Company at Hayden, costing about $2,000,000 is intended to accomplish a somewhat lower cost of handling and improved extraction. The Ray Consolidated has been producing about 5,250,000 pounds of copper per month although it has a capacity of 7,000,000 pounds. During the past year the Ray Consolidated absorbed the Chino Copper Company at Santa Rita, New Mexico. This has made no material difference insofar as the operating ends of the company are concerned.

The Ray Hercules Mining Company has gone by the way of the sheriff's hammer, having been sold at sheriff's sale in November to its creditors. There has been no announcement as to what the new purchasers plan on doing with this property, which has developed several million tons of ore and is a potential producer on a good copper market.

There have been numerous development activities in this county, more particularly in the Superior section. Probably the most promising of these have been the work of the Belmont Copper Company, the Arizona Superior Mining Company and the Silverona.

Yavapai Very Active

"The Big Hole" of Yavapai County, the United Verde Copper Company, has made many steps of progress during the past several years. Its steam shovel mining has continued at a rate of 140,000 to 150,000 yards a month. In July, 1924, it broke all records for previous production, putting out a total of 10,000,000 pounds of copper. It has now developed to the 2,400-foot level and has done some very successful prospecting work on the Venture mine through the Calumet and Jerome property.

During the past several years test work has been going on, aimed toward the concentration of low grade ores existing at the United Verde. Tests were made on a large scale last year at the mill of the Southwest Metals Company at Humboldt. The announcement has just been made that a 1,000-ton milling plant will be erected immediately at Clarkdale, Ariz., to be built under the direction of H. Kenyon Burch.

The construction program of the United Verde since the war, aggregates about $11,000,000 and includes the building of a large modern crushing plant, the remodeling and building an addition to the smelter, the starting of their steam shovel operations which necessitates a complete change in all surface equipment, with new and modern plants, to the 500 level of the mine.

There has been a most unusual community development by this company, including the building of a large number of houses at both Jerome and Clarkdale and numerous other community projects. A contract has recently been let for a $100,000 Memorial Hall for the late Senator W. A. Clark, to be built at Clarkdale.

The United Verde Extension Mining Company has also maintained full capacity. It has continued the exploration of the Jerome Verde property and, while several reports have been spread as to strikes of new ore, they have been as frequently denied by the management. The only recent construction program made by the United Verde Extension has been the building of substantial structures to replace the frame buildings at the smelter town of Clemenceau.

The prospects of "The Third Big Mine" of the Jerome district have greatly improved during the year by the development work being carried on by the Calumet and Arizona Mining Co. at the Verde Central mines. A vertical shaft has been carried to the 1,500-foot level with the installation of the hoist from the Gadsden mine and a new steel gallows frame. Ore has been reported in the shaft at 1,056 and 1,315-foot levels, and it seems to be generally conceded by those who have examined the progress of the work at the Verde Central that another large mine for the district is at hand. The general offices of the company have been transferred to the same location as those of the Calumet and Arizona office, Calumet, Mich.

The big loss to Yavapai County has been the shutting down of the smelter of the Southwest Metals Company at Humboldt, which employed 700 men. It closed down about February 1. The low price of copper was responsible for this condition and, with an increase in the price of the metal, work at this plant can be expected to resume. In fact, at the present time it is anticipated that the plant will be opened shortly.

Smelter of the Magma Copper Company

During the past year it was contemplated to open a section of the plant for the treatment of arsenic ores, but the excitement for arsenic and its unusual demand fell off about as rapidly as it started and nothing was done. The company has continued the development of its Bluebell mine and has found new ore of considerable importance.

One of the most aggressive development programs of the year has been that of the Kay Copper Corporation near Canon. Work started in March, 1924, sinking its shaft from the 760 to 1,200-foot level, and upon the completion of that work a most aggressive program of development by diamond drilling and crosscutting has taken place and several important ore strikes announced, the last one being the striking of the original ore body at the 1,200-foot level, or 600 feet deeper than the previous depth opened. The body of ore at this depth showed for a width of 80 feet and the results of the development work have been sufficiently encouraging to cause a speedy program in opening up this new ore.

The work has been going on for several years in the retreating of the dumps of the old Vulture mine at the rate of 250 tons per day by the Vulture Milling Company, a group of San Francisco capitalists who leased the dumps of this old producer. It is reported that the work has been quite successful in extracting the values remaining from former milling methods.

In the Wickenburg district the Monte Cristo mine has continued development and to date has some 20,000 feet of laterals and is developed to a depth of 1,100 feet. The ore at this depth is showing excellent gold values in addition to copper contained.

The work of the Sheldon Mining Company at Walker has been a considerable interest, particularly with the construction of the plant of 240 tons daily capacity, designed by David Cole of El Paso. Its shaft has been put down to the 800-foot level, with considerable development at that place.

Among the other features of mining operations in Yavapai County have been the sinking to the 1,000-foot level at the Bannie Gold and Copper Co.; the general development work at the Copper Chief Mining Company property and the Verde Cobre; the suspension of operations at the Shea Copper Company; the black sulphide with chalcopyrite encountered at the property of the Howard Copper Company and the erection of a Greenawalt mill at the Howard Silver Company property. There has also been considerable interest in the erection of the washing, crushing and drying plant of the Western Chemicals, Incorporated, which has been operating at Camp Verde for the production of sodium sulphate.

Ball Mills, Hayden Mill, Ray Consolidated Copper Company

Cochise Makes Good Production

Due to the low price of copper and the fact that a greater profit could be made by leaving the copper ore to be mined at a later date, and also to the good price of lead, the principal output of the Shattuck-Arizona Copper Company has been in its lead ores, and it has been mining these ores at the rate of about 100 tons per day, while it has only been taking out its copper at 60 tons per day.

The Denn Mine has recently been merged with the Shattuck-Arizona and the new company is known as the Shattuck-Denn Mining Company. It is stated that the Denn mine, which has been closed down since December, 1920, will be in operation within a short time.

Announcements have been made of a $1,500,000 construction program at the Douglas smelter of the Phelps Dodge Corporation, Copper Queen Branch, and the contracts have been let for the work which will take about one and one-half years.

The operations of the Phelps Dodge Corporation at Bisbee have only been on about a 60 percent basis, or a production of about 12,300,000 pounds monthly, as against a possible production of 18,000,000 pounds. The Sacramento Hill project has been working steadily and providing ore for the new 4,000-ton mill at Warren.

The Calumet and Arizona has completed its remodeling improvements at the smelter totaling about a half million dollars, and it has installed a most modern pumping plant of Prescott pumps to lift the water from its mine, a distance of 2,300 feet. One pump operates at the rate of 1,500 gallons per minute, and two of them at 1,000 gallons per minute. The Calumet and Arizona has been operating close up to capacity, running about 3,800,000 pounds monthly, with a capacity of 4,300,000 pounds.

One of the interesting recent developments has been the deliberate firing of the sulphide ores of the Shannon Copper Company at its mine at Gleeson. The ores at this point have a high sulphur content and comparatively low copper. By setting the mine on fire and permit-

United Eastern Mine and Oatman

Photos by Ransome, U. S. Geological Survey
Tom Reed Mill, Oatman District

ting the sulphur to burn out it is essentially the smelting of copper in place. The fire causes a differential enrichment and changes the copper to the oxide, which may eventually be leached. The work has not progressed sufficiently far as yet to prove the value of the experiment.

The past year has been a very important one in the history of the Central Copper Company with mines at Dos Cabezas, Ariz. The ore reserves of the company have practically been doubled during the past year and plans are now being made in preparation for production during the coming year. David Cole, of El Paso, has been retained as consulting engineer for mill construction and testing work is now going on under his direction. The company is employing about 200 men.

At the plant of the Apache Powder Company, near Curtis, a modern hospital, dormitory and dining hall have recently been erected. The main offices of the company have been moved from Benson to Bisbee.

Maricopa County Inactive

There has been little mining of importance in Maricopa County. Some prospecting in the Cave Creek section for gold and several quicksilver flurries at the Porteria, Hughes, and Rico Properties, northeast of Phoenix.

From the point of view of the mining industry, however, the establishment of the plant of the Industrial Chemical Company at Phoenix, for the manufacture of oxygen, has been a most important item, and that plant is now supplying oxygen to many of the mining companies of the state. There have been numerous other industrial developments in the city of Phoenix of importance to the mining industry.

Little Mining Activity in Pima

As usual, the most important work in mining in Pima County during the past year has been that of the New Cornelia Copper Company, at Ajo. The new 5,000-ton flotation plant has been started, the first unit of this plant being put to work at this property on January 8, 1924, and succeeding units thereafter. The work on this plant was started in October, 1922. The leaching plant is continuing at full production, but the flotation plant has a possibility for production considerably in excess of its present output. The New Cornelia has been producing copper at the rate of about 6,000,000 pounds monthly and has a potential capacity of 7,500,000 pounds. Considerable work has been done at the New Cornelia relative to the development of an ample water supply, and there has been sunk a 650-foot shaft to develop sufficient water, this work being done during 1924.

There have also been frequent reports of activities from the Quijotoa district, but the most important development has been the installation of a mill at the Allison mine. The reports from the Quijotoa section have been of unusually rich gold strikes.

One Big Activity in Greenlee

Since the consolidation of the Greenlee County properties of the Shannon Copper Company with the Arizona Copper Company by the Phelps Dodge Corporation, practically all of the mining done in Greenlee County is now in the hands of one corporation. Upon the completion of the consolidation, plans were made for the most economical operation of the three properties together. These plans involved the discontinuing of the Morenci smelter of the Phelps Dodge Corporation, many improvements in the Clifton smelter, which was constructed by the Arizona Copper Company, and the remodeling and enlarging of the No. 6 concentrator of Morenci. This remodeling work has been completed, giving the concentrator a capacity of 4,500 tons of ore daily, although it has been treating only about 3,500 tons.

Northern Yuma Active

There have been many smaller activities in the northern part of Yuma County, among them being the completion of the 50-ton flotation mill at the property of the Bowyer Gold and Copper Co. at Quartzite, the completion of the 350-ton leaching plant of the Arizona Standard Mining Company at Parker, the installation of the Cottrell plant for the treating of oxidized ores and the operating of the flotation plant of the Signal Mines Company, the development work of the Arizona-Apache Mines Company, the Veteran Mining Company, the Harqua Hala, the Bagdad properties and the Wenden Copper Company. While the Swansea is usually a producer of considerable size and importance, it has been doing nothing of consequence.

General Progress

Hydro-electric power development has progressed only by the starting of construction of the Mormon Flat and Horse Mesa Dams on the Salt River. The Diamond Creek project, in which some of the mining companies are interested in the expenditure of $40,000,000 in a dam and electrical power plants, has been held up awaiting a Federal Power Commission permit. This and all other projects on the Colorado River have been delayed, awaiting the action of Arizona with reference to the Colorado River compact, Arizona having been the only one of the seven states concerned that has failed to ratify. It is believed, however, that the Diamond Creek project, which is all ready to go ahead and complete development just as quickly as a permit is granted, will receive the necessary authority before 1925 is over, as officials have fully complied with all statutory requirements and necessary preliminary work to prove their claims, and the delay is only because of "political expediency."

There has been a great deal of work done in the southwest during the past year in elec- (*Continued on page* 546)

Driveways and Residences in Phoenix, Arix.

ANNUAL MEETING OF WESTERN DIVISION

Annual Meeting Of Western Mining Men In Arizona To Be An Important Milestone In The Development Of Cooperative Action Among Metal Mining Interests—Splendid Program And Interesting Trips Arranged By Local Operators

ARIZONA—the Mining Empire of the Southwest — is a natural place for the annual meeting of the Western Division of the American Mining Congress, which will be held at Chandler, a suburb of Phoenix, Arizona, November 16 to 19, 1925.

As in many other western states, the mining industry in Arizona is the dominant factor in the industrial and commercial developments of the state and the annual meeting of western mining men at Chandler affords an opportunity for mining men from all parts of the country to join together in an interchange of ideas and the formulation of a program which will outline the policies of greatest value to the metal mining industries.

The Arizona mining men who are hosts for this meeting and who have charge of the arrangements for the conference have planned to emphasize the informal character of the discussions at the San Marcos Hotel in Chandler and will make a special feature of the last two days of the convention which will be devoted to a trip over the famous Apache Trail and an inspection of the splendid mining camps at Miami and Globe.

Purpose of the Meeting

The purpose of the annual meeting of the Western Division of the American Mining Congress is to bring together a group of representative men and delegates from local and state mining associations throughout the metal mining districts, in order to discuss vital problems of mutual interest and to create a program of cooperative action which can be presented for adoption at the annual convention of the American Mining Congress to be held in Washington, December 9 to 11.

The western mining industry is the foundation upon which the greater part of the industrial and commercial structure in the great western states has been built. The problems which are now presented to mining companies are of course entirely different from the problems which were of importance in former years. The great ore deposits of the bonanza days have largely been developed and the maintenance and further development of the metal mining industry lines along the line of the introduction of new and more effective metallurgical processes and mechanical equipment which will enable low grade ore deposits to be utilized to a greater degree at a cost which will make possible profitable production. Coupled with the development of new methods, practice and equipment, there must be readjustments in connection with important economic factors such as federal and state taxation, transportation, the development of the markets, each of which plays an important part in connection with further development of mining in this country.

Globe, Ariz., in the days of '49

Program Devoted to Western Mining Problems

The program as arranged at the Arizona meeting provides for four general sessions on Monday, November 16, and Tuesday, November 17, devoted to a consideration of problems of the metal mining industry and informal conferences covering different phases of these problems.

The four major discussions of general economic problems will include:

1. A discussion of the proper functions of the U. S. Bureau of Mines.

2. A consideration of the problems of the silver producers and the opportunities for further cooperative action.

3. Federal valuation and taxation of mines and

4. Railroad freight rates.

Each of these problems is of real interest to all of the mining districts. The recent transfer of the U. S. Bureau of Mines from the Department of the In-

terior to the Department of Commerce has attracted widespread attention. The Secretary of Commerce has appointed L. S. Cates, president of the American Mining Congress as a member of the advisory committee for the purpose of outlining the point of view of the mining industry in regard to the proper functions for constructive work by a government bureau. The discussion of these general topics at the Arizona meeting will form the basis for recommendations to be made to Secretary Hoover in regard to the wishes and thoughts of the metal mining industry.

Although the silver producers have recently benefited from a slightly increased price, there is a splendid opportunity for bringing about the reintroduction of silver in the coinage systems of European countries. Here again the discussions at the Arizona meeting afford the opportunity for the silver producers to express their point of view and formulate resolutions for presentation to the general meeting of mining men at Washington at the time of the annual convention of the American Mining Congress.

Two views in Fish Creek Canyon along the Apache Trail which will be visited by delegates to the Western Division meeting

The two other general economic topics presented for discussion at the Arizona meeting will be federal valuation and taxation of mines and railroad freight rates. Both of these subjects are of primary interest to western mining men. A new tax measure is now being prepared for introduction to Congress, and the mining industry is alert to clauses in this bill which will be applicable to the mining industry. The mining industry bears a heavy burden of local and federal taxes. It is essential that the industry should be safeguarded from oppressive taxation and that its peculiar problems should be recognized in the passage of tax legislation. A discussion of federal valuation and taxation of mines at the western mining conference will do much to assist in bringing about a recognition of the mining industry and to secure fair treatment in connection with the new legislation.

Railroad transportation is, of course, a vital factor in the mining industry. The mining industry furnishes approximately 53 percent of the total volume of freight traffic in the United States and mining pays its share of the freight and requires fair treatment all along the line in order to enable operations to prosper. Mining men appreciate the situation in regard to railroad transportation and the discussions at Chandler will be along the lines of indicating methods by which greater cooperation can be secured between the railroads and mining interests.

Practical Operating Problems to be Featured

For the first time at the annual meeting of the Western Division of the American Mining Congress there will be a discussion of practical operating problems and this discussion should be a real feature of the meeting. Conditions relative to mine production vary greatly in different metal mining districts but at the same time it is realized that an interchange of thought in regard to the handling of practical problems will be of great value to all operating officials. The discussions of practical operating problems at the western mining conference will be centered around the topic of "Handling Materials" and will include:

1. "Underground Haulage and Hoisting at the Inspiration Mines," by A. C. Stoddard, Chief Mine Engineer, Inspiration Cons. Copper Co.

2. "Transportation and Distribution of Underground Supplies at the Miami Copper Company," A. J. McDermid and J. C. Conniff, Miami Copper Company.

3. "Handling Ore and Waste at the Magma Mine," by F. H. Snow, Mine Superintendent, Magma Copper Company.

The discussion of these important topics by such representative engineers should be of great interest and there will be an opportunity for an informal discussion of these topics from the floor.

In addition to the general program there will be an opportunity provided for informal discussions of mine safety, industrial cooperation, stabilization of the mining industry, a luncheon conference on mine timbering problems, as well as reports from a number of committees which have been working along different lines during the year since the Sacramento convention.

The Arizona mining men have arranged for a very delightful trip during the last two days of the convention. This trip will include an auto ride from Phoenix to Globe over the famous Apache Trail which is one of the great scenic drives in the United States. This Trail, which was used in former days by the Indians, is now a beautiful highway taking the visitor from the irrigated garden land surrounding Phoenix over the rugged mountain walls to the famous Roosevelt Dam and Reservoir. The Roosevelt Dam is one of the largest and finest in the world. Additional dams are now being built creating further water storage facilities and the delegates will have the opportunity of inspecting this remarkable development. From the Roosevelt Dam the trail leads on through the mountains to the great mining camps at Miami and Globe. It will be of special interest to all those attending.

To every mining man the opportunity of seeing how the other fellow does it, is one which makes any meeting well worth while. The culmination of the

Annual Meeting, Western Division, American Mining Congress

SAN MARCOS HOTEL, CHANDLER, ARIZ.

MONDAY, NOVEMBER 16

9.00 a. m. Registration of delegates.

10.00 a. m. First general session. Presiding officer, Robt. E. Tally, United Verde Copper Company, Chairman of the Board of Governors of the Western Division.
Reports of Committees.
TOPIC: Proper Functions of the U. S. Bureau of Mines.
Speakers: L. S. Cates, President of the American Mining Congress; J. F. Callbreath, Secretary, the American Mining Congress.
Informal discussion.
Formation of Resolutions Committee.

2.00 p. m. Second general session. Presiding officer, Robt. E. Tally.
TOPIC: Federal Valuation and Taxation of Mines.
Speaker: A. G. Mackenzie, Salt Lake City, Utah.
Informal discussion.

8.00 p. m. Informal conferences relative to safety in mines, industrial cooperation, etc.

TUESDAY, NOVEMBER 17

10.00 a. m. Third general session. Presiding officer, Robt. E. Tally.
TOPIC: Cooperative Efforts on the Part of the Silver Producers.
Speakers to be announced.
TOPIC: Railroad Freight Rates.
Speaker: C. H. Blaine.
Informal discussions. Report of Resolutions Committee.

2.00 p. m. Discussion of Practical Operating Problems. Presiding officer, Robt. E. Tally.
TOPIC: Handling of Materials.
Under the supervision of Guy N. Bjorge, associate editor of the Mining Congress Journal.
1. Underground Haulage and Hoisting at the Inspiration Mines, A. C. Stoddart, Chief Mine Engineer, Inspiration Cons. Copper Co.
2. Transportation and Distribution of Underground Supplies at Miami Copper Company, A. J. McDermid and J. C. Conniff, Miami Copper Company.
3. Handling Ore and Waste at the Magma Mine, F. H. Snow, Mine Superintendent, Magma Copper Co.

WEDNESDAY, NOVEMBER 18

8.00 a. m. Automobile busses will leave the San Marcos Hotel for the trip over the Apache Trail, visiting the Roosevelt Dam and Reservoir.

12.30 p. m. Luncheon at reclamation project construction camp.
Speaker: C. C. Cragin.
TOPIC: Reclamation Developments in Arizona.

5.30 p. m. Arrive in Globe.

7.00 p. m. Informal complimentary banquet to visiting delegates at Globe.

THURSDAY, NOVEMBER 19

9.00 a. m. to 5.00 p. m. Inspection of copper mining plants, mills and smelters of the various copper mining enterprises. Delegates will select mines which they desire to visit.

5.00 p. m. Adjournment.
Delegates can either return to Phoenix or make arrangements to take train (Southern Pacific) from Globe.

convention will be the opportunity presented to all delegates attending the meeting to inspect the splendid modern copper mines, mills and smelters of the Inspiration Cons. Copper Co., the Miami Copper Co., the Old Dominion Copper Co., the Arizona Commercial, the Iron Cap, the Butte and Superior Copper Co. plants.

These plants are among the largest and most efficient mining enterprises in the world and the opportunity to inspect these plants under these conditions is a splendid inducement for every mining man to make a special effort to come to the Arizona meeting.

Opportunity for Pleasant Recreation

All of the meetings of this western mining conference will be held at the San Marcos, Chandler, a suburb of Phoenix, Arizona. The San Marcos Hotel is located in the center of one of the most successful and prosperous reclamation projects in the United States. The developments along agricultural lines in the Salt River Valley during the past twenty years has been marvelous and the entire valley is a veritable garden of production ranging from the citrus fruit to canteloupes, dates and all forms of agricultural products.

Along the Apache Trail; Above, Roosevelt Lake; Below, Roosevelt Dam

The San Marcos Hotel itself is a delightful, homelike resort hotel with every facility for the entertainment of its guests, including a well bunkered golf course, splendid automobile drives and all of the other usual forms of recreation.

Local Arrangements

All of the local arrangements for this western mining conference are in the hands of W. B. Gohring, secretary of the Arizona Chapter of the American Mining Congress, 419 Heard Building, Phoenix. Reservations should be made direct with Mr. Gohring and any further information desired will be sent out upon request from his office.

Railroad Transportation

Chandler, Arizona, can be reached over the Southern Pacific or the Santa Fe Railway System. All tickets should be purchased to Phoenix, (*Continued on page* 561)

COPPER'S PLACE IN THE SUN

Leaders In Copper Production Believe That The Industry's Future Is Bright—A Survey Of The Present Outlook For The Red Metal By L. S. Cates, Stephen Birch, Cleveland E. Dodge, R. L. Agassiz And Gordon R. Campbell

Louis S. Cates, Vice-President and General Manager, Utah Copper Company:

Copper is now coming on the world market in greater volume than ever before in history. World production in the first half of the present year was at the rate of more than three billion pounds per annum, or more than six percent greater than the war-time peak. Yet current production is being consumed and reports indicate that stocks on hand are materially less than at the first of the year.

The fundamental reason for the tremendous increase in copper consumption is more varied use of the metal. This is not attributable alone or chiefly, in my opinion, to construction or reconstruction made necessary by the World War, but rather to natural development.

The rapid extension of electrical construction and widened use of electrical appliances of all kinds, the growth of the automobile industry, the advent of radio and air transportation and the greater and growing employment of copper in construction of buildings and machinery all are new factors in the copper situation. It was stated recently by one of the world's leaders in the copper producing industry, the ordinary street car contains 2,500 pounds of copper, a steam locomotive 3,000 pounds, an average automobile 36 pounds, exclusive of its electrical wiring. A hundred million pounds of copper is used annually in this country for journal boxes on railroad cars, the automobile industry uses 150,000,000 pounds, the building industry 225,000,000 pounds. Power installations use about seven pounds of copper per kilowatt and radio receiving sets about five pounds each. Much of this represents new uses of copper that are likely to expand. Probably the greatest factor, however, is the remarkable development and extension of electrical transportation and communication, here and abroad.

The obvious conclusions from observation of the world's development are well supported by authentic statistics of the copper industry. The World War period is eliminated from consideration, not only for the reason that it introduced abnormal conditions, but also for the reason that adequate and trustworthy data for the war years are not obtainable.

Figures compiled by the American Bureau of Metal Statistics disclose that electrical manufactures, telephones and telegraphs, light and power lines, wire and rods, automobiles and buildings consumed 53.10 percent of the current United States production in 1919, but took 68.34 percent of the current production in 1924, which latter was 35.45 percent greater than in 1919.

United States exports of copper in 1924 show an actual increase of 18.29 percent over the year 1913. Exports in 1913 amounted to 75.40 percent of that year's domestic production and in 1924 amounted to 66.89 percent of the 1924 production, which is equivalent to 89.18 percent of the 1913 production.

The United Kingdom, France, Germany and Italy took 69.36 percent of the United States exports in 1913 and 69.05 percent in 1924. Actual exports to the four countries were 17.77 percent greater than in 1913, or 378,267 tons in 1924 as compared with 321,199 tons in 1913. The increased takings of the United Kingdom, France, and Italy more than offset the reduction in exports to Germany, although Germany's consumption of United States copper was only 32.02 percent less than in 1913, or 104,395 tons in 1924 as compared with 153,575 tons in 1913. Exports to the United Kingdom were 80.08 percent, to France 22.50 percent and to Italy 162.86 percent greater in 1924 than in 1913.

These figures need no further elaboration, when considered in connection with other well-known facts, to demonstrate that the world situation justifies the conviction that the copper market is broader today than ever before in history, that it will expand further and that the present situation is the result of natural development, not of artificial or abnormal conditions.

There is great necessity for revision of the Federal laws which prohibit proper productive cooperation among the producers of basic materials from natural resources. If this were possible, it would prevent much waste of our country's assets due to the drastic drop in prices when production is greater than consumption for any considerable period of time. Properly regulated associations and understandings among producers should be permitted by our Government if we are to retain our preeminent position in supplying raw materials to a large part of the world. No more constructive legislation could be enacted for the benefit of the copper industry than a law permitting such mutual regulation by producers as would prevent violent fluctuations in output and those dangerous reflections in price whether up or down.

Stephen Birch, President, Kennecott Copper Corporation:

The remarkably large consumption of copper during the year 1924 and thus far in 1925 has been due largely to the great increase in the manufacture of electrical appliances and to its increased use in the building trade in the form of hardware, copper roofing, gutters and leaders, and brass pipe and fittings. Largely because of the efforts of the Copper and Brass Research Association, the public has, to a great degree, become educated to the superiority of and real economy in the use of copper and brass. As this knowledge becomes more general, the rapid growth of the population of the country and the constant need for more and better houses will mean a greatly increased demand for copper and brass in new construction and replacements.

The adoption of electricity for the conservation of fuel is practically an economic necessity. Particularly is this true in Europe where extensive hydro-electric development projects are contemplated. New construction work in the United States during the past two years has been and still is proceeding at an unprecedented rate. On the contrary, there has been comparatively little new construction in Europe and reconstruction has been neglected to a great degree due to lack of funds. Even under prevailing conditions, each year from 1919 to 1925 shows a considerable increase in refined copper exported to Europe over the previous year and it is the natural and logical assumption that this growth will continue. Still, the consumption of copper in Europe during 1924 was 16 percent less than that in 1913. As against this, consumption in the United States increased about 90 percent for the same years. These figures, I believe, clearly portray the large potential foreign demand. Great forward steps in the rehabilitation of the countries in Europe must come, and with them a commensurate increase in the consumption of copper. This, with the anticipated steady increase in domestic demand, indicates brighter immediate prospects as well as future permanent prosperity of the industry.

Cleveland E. Dodge, Vice-President, Phelps Dodge Corporation:

Owing to extraordinary improvements in metallurgy, as well as to many enlargements of plants within the last few years, the capacity to produce copper has over-reached consumption. By a process of normal growth, however, the demand is catching up to the supply. This process has been retarded by the financial crisis in Europe, resulting from the war, for the market for copper is dependent upon world conditions.

Looking toward the distant future, I believe that there is every reason to have faith in an increasing use of copper that will require a far greater production than is now possible. This will be caused in our own country largely by increasing population, and in Europe by a growing use of electric lights, telephones, electrification of railroads, and other developments that make use of the metal necessary. There will be an even greater relative growth in the more backward nations.

The law of supply and demand has always controlled the copper market and I imagine always will. At present few mines are producing to capacity, many higher cost properties are closed down and several large companies, especially in South America and South Africa, are eager to undertake new construction so as to increase their output. I do not, therefore, expect to see a real boom in copper for a number of years, but the industry as a whole will be best served if the market avoids fluctuations.

If the Security Compact can be signed soon in Europe and settlements made of debts to the United States, there is every reason to believe that Europe will require more copper. In our own country the consumption is greater than ever before and, with the condition of general business looking better, the prospects for copper are bright. Therefore, as far as the near future is concerned, by which I mean the next year or 18 months, I look for a gradual increase in demand and probably in price.

R. L. Agassiz, President, Calumet and Hecla Cons. Copper Company:

Since the beginning of the year the world has been consuming copper at a rate unprecedented for peace times. Temporarily, there is a slight slackening of the domestic demand, but all reports from the principal consuming industries warrant belief in an expansion, rather than a restriction of activities during the fall and winter months. Copper metal is still all out of line with other standard commodities in price, compared with pre-war levels, but a considerable degree of stabilization seems to have come about and the improvement, if slow, has been steady and unaccompanied by violent reactions.

I think the outlook for copper is excellent; better, in fact, than at any time since the signing of the Armistice left the industry in so deplorable a condition that by 1921 it was necessary as a measure of preservation to close down the principal mines.

A glance at the latest figures available will give some idea of the rate at which the United States, and the countries to which she exports her copper, are consuming the metal. During the first eight months of the year shipments were 118,000,000 pounds in excess of production, which excess was shipped from surplus stocks. Had export business held up in July and August to the levels of the first six months, this excess would have been even greater. As a matter of fact, the average loss in exports for July and August, compared with the monthly averages for the first six months of the year, was close to 17,000,000 pounds. During the same two months the average gain in domestic shipments over the average for the first six months was about 9,500,000 pounds, partially offsetting the loss in export business. Total shipments, domestic and export, between January 1 and August 31, were 1,896,652,000 pounds; total production for the same period was 1,778,470,000 pounds.

The falling-off in foreign demand is, I believe, merely temporary. Europe is extremely sensitive these days and the slightest industrial unrest or uncertainty, such as we have recently seen in England, reflects itself in business generally.

With the statistical position strong, consumption running slightly ahead of production, the electrical, building, automobile and other large consuming industries going at full speed, the outlook for copper is, in my opinion, most encouraging.

Gordon R. Campbell, President, Calumet and Arizona Mining Company.

To say that the "statistical position of copper" is better than at any time since the Armistice is trite.

Consumption of copper is the largest in the history of the world, and, if the same good business policy is displayed by the leaders in the industry as is shown by leaders in other industries, the adjustment of production at a reasonable profit to consumption and the stabilization of the market at a price satisfactory to both producer and consumer should be readily effected.

If such is the consummation of present conditions, copper mining will enjoy an indefinite period of great prosperity.

FUTURE PROSPECTS OF THE GOLD MINING INDUSTRY

THE high cost of labor and supplies is almost the only cause for the depression existing at present in the gold mining industry. Conditions can be expected to improve only if these costs become less.

High prices may be ascribed to at least two causes—the demonetization of gold in a number of countries, and high taxes. Demonetization was a result of the war, and it seems quite certain that every country will return to a gold basis as soon as enough gold can be accumulated. This should have the effect of lowering prices.

That high taxes must cause high prices can be demonstrated. The amount paid in taxes must be added to the cost of doing every kind of business; it must be added to rents, to freight and power rates, and increases the price of goods every time they are handled. This inevitably increases the cost of living, therefore wages must be raised, which again must be added to the cost of doing business. This in turn adds to the cost of government for which the taxes are raised.

In order to maintain prices at a level high enough to pay the taxes it is necessary to protect industry by means of a tariff. The unfortunate gold miner, however, receives no such protection. Only if the government should refuse to sell gold, and should levy a duty on imported gold would he be in the favored position of other industries.

One reason for the high cost of government may be a certain trend toward paternalism. Free school books, old age pensions, etc., must be paid for.

The mines themselves have to pay out large amounts in direct taxes, but this is only a small part of the extra costs that they are now laboring under as compared with costs before the war.

The decreasing of Federal taxes will help a little, but the local taxes are the most burdensome, and there seems to be little indication of their being reduced.

There has been a period of high prices after every great war, getting back to normal in from ten to fifteen years. This seems to offer the greatest hope for the future.

To recapitulate, the world wide return to the gold standard and the decrease in Federal taxes will help the present situation, but there seems to be no immediate prospect of of a complete return to normal on account of the excessive cost of local government.

ARTHUR B. FOOTE, President,
The North Star Mines Company.

The Bureau of Mines has recently issued a report on the metallurgy of quicksilver.

THE OUTLOOK FOR SILVER

Analysis Of Supply, Demand And General Price Level, As Affected By The Gold Supply, Indicates That The Outlook For Silver Is Encouraging—Rehabilitation Of Subsidiary Coinage By Use Of Silver, By European Countries Of Benefit To U. S. Producers

By W. MONT FERRY*

THE analytical method for determining the future price of a commodity is generally recognized as the best one by economists of international repute.

Silver is, of course, a commodity, yet it is also a money metal, being used for exchange purposes by a very substantial part of the world's population. Furthermore, it is practically indestructible and the unknown and unknowable billions of ounces that have accumulated in the world are a tremendous factor to be considered in any attempt to intelligently forecast the market price for the metal. Students of the question and economists generally recognize this fact also.

Within the confines of a short article and with the limited time given, it is, of course, impossible to more than touch the high spots in the discussion of this subject.

No originality is claimed by the writer. Well recognized authorities have been referred to. The conclusions reached by consulting these authorities and such current information as is available are believed to be sound.

Supply, demand, and the general price level, as affected by gold supply, are the most important factors in reaching a conclusion.

The supply of silver is not materially increasing and there seems to be small possibility that any considerable supply from new discoveries will be made. Metallurgical practice may and doubtless will increase the recovery of silver from known sources to some extent, but it is not probable that any startling method will be devised which will materially add to current production. It is interesting to note that the recovery of silver from lead and copper ores has shown a steadily decreasing proportion during the last 20 years, and it is probable that this proportion will not materially increase. Copper is being produced more and more from the large so-called porphyry mines and these ores carry a small amount of silver per ton. Likewise, silver-lead mines which contribute a substantial part of the total silver production have a tendency to show a decrease in silver content as depth is attained. Complex ores are now being successfully treated and their values recovered. These ores contribute somewhat to the silver supply but can not be deemed a governing or even an important factor in the general situation.

It is entirely reasonable therefore to conclude that the supply of silver from producing mines, from new mineral discoveries and from advancing metallurgical recoveries, will not materially increase.

The demand for silver is for coinage purposes and for use in the arts and industries.

Dr. L. C. Graton, Professor of Economic Geology of Harvard University, states that for the past 10 years the total world coinage has exceeded the total world production of silver for the same period by 300,000,000 ounces, showing rather conclusively how serious the need is for silver in the money scheme of the world.

From 1914 to 1918, 14 countries debased their silver coinage, some to the extent of 50 percent, and used the resulting bullion for additional money in an attempt to satisfy the demand of the people for metallic money during the crisis of the four years World War. Even then the demand was not satisfied, as was evidenced by a number of important events connected with silver with which the world is familiar.

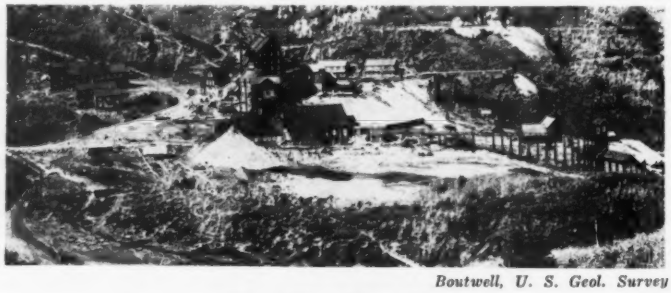
Now, these countries are beginning to rehabilitate their subsidiary coinage by buying silver for that purpose. For the past two years a number of the countries of middle Europe have been in the market and recent authentic information indicates that Germany proposes to buy at least 30,000,000 ounces per year for an indefinite number of years in order to restore to her government and to her people the money and other articles of silver melted up and used during her unsuccessful struggle to conquer the world.

In the arts and industries there is an increasing demand for silver. The increase in wealth throughout the world and the rapidly improved standard of living among the people are creating a larger demand for objects of art and use made of the white metal. Incidentally, it is proposed by the American Silver Producers' Association, in connection with other agencies, to undertake means which will result in an increased demand for the purposes indicated.

Photography, and especially the moving picture business, are taking a tremendous amount of silver every year, which is increasing as the business grows. It should be noted that this use of silver is perhaps the only one, or at least the largest one which results in the destruction of the metal.

General price level of commodities, of course, affects the price of silver. Professor Irving Fisher, head of the Department of Political Economy of Yale University, is of the opinion that the general price trend is still upward and that it will continue to be high for a long time. Other economists of recognized standing are of the same opinion.

From the foregoing statements of facts based on the conclusions of very eminent authorities after careful study it may safely be predicted that the outlook for silver is encouraging and that the price will have a strong upward tendency.



Boutwell, U. S. Geol. Survey

Silver King Mine, Utah

CEMENTATION OF COPPER BY SPONGE IRON

SPONGE iron has many advantages over scrap iron as a precipitant for copper. The Bureau of Mines has completed an investigation covering the rate of precipitation, grade of product obtainable, completeness of precipitation, and effects of temperature and acidity, using various sponge iron products under different conditions. It was found that sponge iron precipitates copper much more rapidly than does scrap iron or detinned scrap. The precipitation must be carried out in specially designed apparatus.

*Managing Director, Silver King Coalition Mines Co.

XUM

Tidal Basin, Washington, D. C. *© C. O. Buckingham*

"When evening hangs her lantern in the sky."

THE INCREASING USE OF MANGANIFEROUS IRON ORE

The Addition Of The United States Steel Corporation To Those Using Manganiferous Ores In Metallurgical Practice Makes The Future Of This Industry Well Established

Clement K. Quinn, President, Clement K. Quinn & Co.:

THERE is steadily accumulating evidence as to the increasing use of manganiferous iron ores in blast furnace practice, this being true at both steel works furnaces and at merchant furnaces making foundry and other grades of iron. This demand has been brought about through the wider appreciation of the advantages to be gained by the use of such ores.

Clement K. Quinn

Some steel works' furnaces have made it standard practice for many years to use mixtures containing more than an ordinary amount of manganese and among these the demand is steady and in general is for an ore containing from 5 to 10 percent manganese. It has been demonstrated through actual practice and experiments conducted for the purpose, that there are numerous advantages in this and it is now generally accepted that manganiferous ore in the blast furnace has a beneficial effect upon the general operation of the furnace. It is more recently, however, that the use of a high-manganese pig iron has been demonstrated to be of advantage in the open-hearth furnace.

These late developments have a direct bearing upon the increasing use of manganiferous ores, because the logical way to obtain high manganese pig iron is through the use of a manganiferous iron ore in the blast furnace. The percentage of manganese in the furnace mixture varies according to the makers' beliefs and practice. Some prefer to use a large tonnage of ore running comparatively low in manganese, say about five percent, while others for various reasons find it of advantage to use a small tonnage of an ore running much higher in manganese than that figure. There is no question, however, but that present practice involves the use of a mixture carrying a *much* higher percentage of manganese than would have been used 10 years ago. At that time it was only in exceptional cases that an ore containing over one percent manganese was used at all, while today, with most of the important plants in the country carrying over one and one-half percent manganese in their metal, it has become necessary to include in the burden an ore containing at least five percent manganese.

J. Wilbur Van Evera, Secretary, Gordon Mining Company:

The manganiferous iron ores of the Lake Superior district were first recognized during the World War as having a value other than as a medicine or a furnace tonic. During that time basic pig iron containing two to two and one-half percent manganese was sold at premium prices. Since then the consumption of manganiferous iron ore has been in an increasing proportion to the consumption of all Lake Superior ores. At the present time very few makers of basic pig do not carry it as a regular mixture in their furnace charge.

Just now the manganiferous iron ore industry is suffering from the effects of over-development along with iron ore in the Lake Superior district in general, but the feeling that manganese in an iron ore is a detriment has been practically eliminated and this year the largest consumer of Lake Superior ore has come into the market and purchased substantial tonnages of manganiferous iron ore for its own use. The future of this material is closely bound up with the future of the Lake Superior iron ore industry. The advantage of using it in the manufacture of basic pig is now generally recognized and it may be confidently expected that the future production of low silica manganiferous iron ore in the Lake Superior district will be in increasing proportion to the total ore production.

Carl Zapffes, Manager, Iron Ore Properties, Northern Pacific Railway Company, Brainard, Minnesota:

The largest reserve of manganiferous iron ore in the United States is generally conceded to be in the Cuyuna iron ore district, in Minnesota. Inasmuch as the states of Michigan, Wisconsin and Minnesota produce annually about 80 percent of all the iron ores used in the iron and steel industry of our nation, the production of any class of ore in the Lake Superior region is representative of the current metallurgical practice in the industrial area supplied with Lake Superior ores. Three percent of the present annual tonnage produced, of all classes, is manganiferous iron ore. Such ores are produced in some of the other Lake Superior districts, but none will average as high in manganese as the Cuyuna ores. What has been transpiring in the Cuyuna district may, therefore, be taken as a reliable indicator of the future of manganiferous iron ores.

The use of manganiferous ores is primarily a matter of chemistry and metallurgical practice; but the large increase in the number of open-hearth furnaces and the decline of the importance of steel made by the bessemer process, make possible a greater use of manganiferous ores than but a few years ago, and the preva- (*Continued on page* 572)

Mahnomen Mine, Ironton, Minn.

THE CONSEQUENCES OF THE ANTHRACITE STRIKE

A Statement Of Developments To Date And An Indication Of What The Cost Will Be To The Miners And Operators Involved

By GEORGE H. CUSHING

THE dominant coal question today is: What is going to be the outcome of the anthracite strike? What, to most men, the question means is: When will it be settled and on what terms?

To answer that question, someone would have to operate under his prophet's license because, as yet, there isn't the slightest indication that either side is beginning to start toward a termination of the strike. And, until those who are interested make some move toward peace, it is clearly out of the question for others to say where the peace negotiations are to end.

The only questions as to the future that are discussible concern themselves with movements that already have been started. Those things have some momentum; as they proceed, they will gather more momentum. And, the longer they travel, the faster they will go. It is possible, therefore, to compute with a degree of precision—modified by the fact that we are dealing with men and not with mechanical forces—what the outcome will be.

Clearly, the first movement has to do with a new purpose, if not, indeed, form of organization for the union. This strike completes about 25 years of union history in the anthracite field. There was, it is true, a union movement in anthracite before 1900, but it was purely preliminary to the appearance of the United Mine Workers of America. Even during the first 15 years of this century, the principal effort of the present union was to establish itself. Therefore, the effective history of the union practically embraces the last 10 years. In that decade, there have been six wage increases coming at regular intervals between April, 1916, and September, 1923. Expressed in the earning power of the men—as distinguished from the mere percentages expressed in the scale—the result has been amazing. For the purpose of this comparison, we will say that the earning power of the miners in the first three months of 1916 is represented by an index figure of 100. The earning capacity of the same men today is represented by an index figure of 292. That is, the earning capacity of the men has been nearly trebled by six wage increases in 10 years. These same men today are on a strike for another 10 percent increase, compounded on the other six. To grant it, would carry the index figure up to about 325.

Starting with New Year of 1916, the cost of living was represented by an index figure of about 115. It rose at one time so high as an index figure of about 225—in April, 1920. Then it began a sharp decline which has continued until today, when it is represented by an index figure of 173.

That is, the index figure of the present anthracite wage is 292; that of the present cost of living is 173. The difference in index figures in favor of the anthracite miners' earning power is 119. Therefore, out of the present wage, the anthracite miner can live as he did in 1916 and still save more money each year than he made in 1916. And, while the cost of living is continuing a downward trend, the anthracite miners are asking that their wages shall continue to rise. These figures, incidentally, are taken from reports of the U. S. Department of Labor.

The Miners' Union—the officers persuaded the men into concurrence—has called a strike to force the granting of a wage schedule which is thus shown to be wholly out of line with anything which seems reasonable. The operators have refused to grant it; the consumers refuse to pay it; and, the government has refused to interfere in behalf of the men. This means that there has come a division with the Miners' Union on one side and all of society on the other. This must have a certain consequence as time goes on—an outcome as inevitable as death itself. And it is that fact which must have its consequences. The union officials have been indifferent to the opinions of society. The members have never expressed themselves. At the moment, the members are facing the necessity to make a commitment—to the union or in conformity with the dictates of society.

Heretofore, the miners were held in the union and on strike by the fact that their actions were so thoroughly discussed by the newspapers, the public and the government officials. They looked upon themselves as sort of national heroes; some of them almost arrived at the point of believing that they were martyrs. Therefore, when the strike was prolonged and the public discussion rose to an anthem, they tightened their belts a notch or two and lived along in their glory. This year, however, an ominous silence has fallen over the strike. Nobody is discussing it. And, try as they will, the newspapers cannot find much of anything to say about it. The miners feel themselves cut off from something precious and material. This is causing them to discuss with even greater zest the question:

"Of what value to us is this union?"

They are becoming uneasy and that fact is ominous for the future of the Union.

Such desultory discussion of the strike as is indulged in, centers in one question:

"Can any industry pay to any group of men an increased wage every time there is a new wage agreement? Is there, after all, a limit beyond which wages for physical labor cannot possibly go?

This insistent question has led the miners, for the first time, to question the wisdom of their union leaders. And that questioning is one of the big forces that has begun to exert itself. It is the climax. It may not bear fruit at once. We may pass entirely through this strike without any serious disagreement between the miners and their present leaders. Just the same, the seed of doubt has been sown, and it is going to grow into something—perhaps a complete reorganization of the union.

This tendency has not been relieved by the proposal of unsound programs. That is, John L. Lewis, in his Hazelton speech, emphasized the three big points in the strike, viz: a 10 percent increase; the equalization of wages; and, the check-off. This has put in words the very subjects concerning which the anthracite miners have the greatest doubts. And, they are not in full accord with any one of the three objectives.

The anthracite miners say they are not willing to strike for wages which the people refuse to pay. That is an important item but a far bigger one is the fact that the practical or "contract" miners alone have any skilled work to do. And, they constitute but 25 percent of the total. A practical miner must pass through an apprenticeship of at least two years before he can get a state certificate. On the contrary, the other 75 percent of the mine workers can become proficient in their work easily in a month, and generally in a week. The skilled worker is hard to replace; the unskilled worker can be replaced at any hour. The fact that the skilled worker is paid well for his effort is no justification for paying the unskilled worker. Thus, the key men do not support Lewis' demand that wages should be equalized.

Finally, since the check-off has become an issue, the anthracite miners

have studied it in operation in other parts of the coal field. If the anthracite miner joins the union, he will pay his dues. And, he prefers to do it rather than have it taken from him. As he expresses it: "In the bituminous field you don't pay your own bills; they take the money out of your pay envelope."

Also, the check-off—for the moment Mr. Lewis says it is a limited check-off—provides for the collection of all "*fines*" and "*assessments.*" This means: If the union wants to carry on a bituminous strike, or to conduct a campaign of conquest in the nonunion bituminous field, assessments will be levied against the anthracite miners. And the mere assessment by the International Union becomes the law of the union.

The anthracite miners are not in sympathy with any of the three demands. At the moment, there may be no open revolt against the union. But, the seed of dissatisfaction has been sown. And, the seed will mature, in time—maybe in the reorganization of the union. This is omnious. It means that the disintegration of the union already has begun.

All of these forces of distrust of and secession from the union have begun to take direction. Before the anthracite strike was called, a movement had started in the Pittsburgh district to give the Union an autonomous government. Lately, the same possibility has been discussed in the anthracite field. It is the logic of everything said heretofore. This discussion is accelerated by the fact that the miners believe that this strike was called to accomplish a purpose in the bituminous field. When they realize that they are affiliated with the bituminous miners, who outnumber them four to one and when they are being forced to pull these bituminous chestnuts out of the fire, they are growing uneasy. For that reason, they are interested in autonomy. Thus, the seeds of secession from the International Union have been sown. It is difficult to see how the International Union can live under these forces of disunion.

The strike has not been without its consequences to the operators. That is, they increased the prices on their prepared sizes, somewhat, following the 1923 increase in wages. Also, they spent a considerable sum of money and a year and a half of effort in a campaign to increase the sale of the depreciated sizes at a better price. They have, wherever possible, increased their own efficiency in order to reduce costs. Despite their best efforts, one of the outstanding companies reports that its mine realization in 1924-5 was 45 cents a ton less than it was two years ago.

Also, they have learned that their last slight increase in prices had proved "the straw which broke the camel's back." In parts of the anthracite-consuming territory, many consumers transferred their business. Some have gone to oil; some to semi-bituminous coal; and, some to the use of artificial gas for heating purposes.

The instant the strike was called, the governors of the New England states assembled in solemn conference and recommended the use of substitutes. This but accelerates a movement which the price already had started. That means that the whole business is put in jeopardy by the union.

These various things are mighty forces which have been turned loose. They may, possibly, influence the settlement of this strike by urging both sides of this bitter controversy to do something to save the business. But, whether the influence is immediate or delayed, this strike has set in motion certain forces, the influence of which will be exerted long after the strike has become history. To the union, these facts spell a need for reorganization and the recasting of its purpose. To the industry, it means the beginning of a most intensive fight for markets—for an opportunity for both the labor and the capital to find employment. The anthracite industry has been traveling for years toward a crisis. It reached it in this strike.

WARRINER REPLIES TO LEWIS' CHARGES

During an address before the Pennsylvania State Chamber of Commerce at Harrisburg on October 15, S. D. Warriner, chairman, Anthracite Operators' Conference, made the following statement, in reply to certain remarks made by John L. Lewis before the convention of the American Federation of Labor:

"I feel compelled, by reason of the astonishing statements made by Mr. Lewis yesterday in his address to the American Federation of Labor, to divert for a moment from the course of my remarks on the anthracite situation.

"When a man, who has arrogantly declined to face the facts in the situation by submitting them to arbitration, takes upon himself to vilify the industry in words which are so far removed from the truth as to approach libel and actual falsehood, a reply is definitely required.

"He makes two principal charges: First, that the anthracite industry has planned deliberately to mulct the people out of some $16,000,000 to $20,000,000 a year. It is true that the industry did last April standardize its sizes of coal. Some sizes were made slightly larger and some were made smaller. This was done at the urgent request of the retail trade, who desired more completely to conform to the requirements of their customers, but only after the operators had made careful experiments as to the feasibility of the changes suggested and had subjected the new sizes to most careful analytical and engineering tests, and had been assured that no advantage would be taken of the public, which would be protected in any action that might be taken. So far as the results obtained in realization or profits to the industry as a whole are concerned, there was no benefit. As evidence of this the realization from the production of our company for the month of August of this year, after the change was made, was $5.68 per ton as compared with $6.14 per ton average realization from the production of our company for August of last year, before the change was made.

"The second charge he makes, namely, that the industry has been a slaughter house, where, since 1870, 1,200,000 employes have been butchered, is equally false. Analyze for yourselves these figures. He implies at least, if he does not say, that an average of 22,000 men annually have been killed in the anthracite industry. The statistics of the Mine Inspection Bureau of the Commonwealth of Pennsylvania show that since 1870 the fatal accidents have totaled 23,745, or an annual average of 431.7. The total number of fatalities in the 55 years from 1870 to 1924 inclusive was a little more than the average number per year which Mr. Lewis states as the number 'butchered.'

"Mr. Lewis says that last year thirty odd thousand men were maimed. This represents the total number of accidents including those, no matter how trivial, that are reported to the Compensation Board. If an anthracite employe gets a slight cut or abrasion on his finger from which any infection might occur, this is reported as an accident to the compensation authorities of the comcompanies and consequently to the state. The fact of the matter is that fully 80 percent of the total injuries reported are of a nonserious character which do not necessitate any material loss of time. If Mr. Lewis' statement were to be taken at its face value the entire labor supply of the anthracite region would have to be replenished every five years—a manifest absurdity.

"Pertinent to this subject I quote from a report just issued by Frank Hall, Deputy Secretary of Mines of Penna.:

" 'Fifty percent of the accidents are due to negligence or carelessness. The fatalities in and about the mines, however, notwithstanding the many dangers that constantly menace the workers, are fewer in number proportionately than among railway employes.' "

LEGISLATIVE FORECAST

Tax Revision Heads The List On Legislative Program For Sixty-Ninth Congress Which Will Convene December Seventh—A Considerable Volume Of Mining Legislation Is Scheduled For Early Consideration

REDUCTION of federal taxation will be the prime objective of the Sixty-ninth Congress, which convenes on Monday, December 7. While many other legislative proposals will be advanced and pushed by their advocates, congressional leaders will confine their main activities to revising the tax law and passing the annual appropriation bills for the support of the Government during the year beginning July 1, 1926. The forthcoming meeting of Congress will be the first session of the Sixty-ninth Congress and may continue indefinitely, although it is expected that the session will be terminated in the Spring or early Summer of 1926. The new session will begin with a new slate and many new members in both the House and Senate, due to changes caused by the 1924 elections and by death. The recent death of some of the outstanding leaders of the progressive element, including Senators La Follette and Ladd, is expected to minimize the influence of the insurgents and to assure a session of less party wrangling than was witnessed in the preceding Congress.

The Senate has already organized for business and is expected to take up legislation at the beginning of the new Congress. This condition is due to the fact that at a short extra session held last March the Senate appointed its officers and committees and will be ready to commence business. In fact, it already has unfinished business in the shape of a resolution of Senator Trammel, of Florida, for investigation of oil prices by the Federal Trade Commission. This resolution was pending when the extra session closed.

In the House, organization of that body will be the first order of business. Nicholas Longworth, of Ohio, will be elected Speaker, and John Q. Tilson, of Connecticut, Republican floor leader in charge of the legislative program. Appointment of House committees will then follow and that body will be ready early in the session to take up the tax revision bill. This bill is now being drafted by the Ways and Means Commitee, which was unofficially designated by congressional leaders at the close of the last session. From October 19 to 29 this committee held hearings on the tax bill and is preparing to present it to the House and secure its passage before the Christmas recess. Congressional leaders hope the bill may be passed by the Senate and approved by the President before the income tax returns for 1925 are made on March 15, 1926.

Here and there are heard proposals to revise the tariff law, but as the Administration is opposed to tariff tinkering, legislation of this kind is not expected. Among the tariff proposals heard are those for an import duty on copper and for repeal of the flexible tariff provision.

Coal Legislation

The anthracite strike is expected to bring forward a number of proposals to regulate the coal industry and to prevent strikes. Serious doubt is entertained, however, whether any legislation along these lines will be enacted. While an anti-strike law would be welcomed in many quarters, the difficulty of obtaining such a statute and enforcing it is conceded. General regulation of the coal industry is also a doubtful possibility, as leaders of other industries would throw their weight against it, because of the fear that such regulation may be extended to all industries.

The session promises to bring forward a number of measures affecting the mining industry. Bills are expected to be introduced to create a Department of Mines and Mining. Congressmen from mining regions feel that the mining industry should be recognized by a Federal Department, but their plans are likely to be embarrassed by the recent transfer of the Bureau of Mines from the Interior Department to the Commerce Department and a plan to authorize the President to rearrange bureaus in the various departments with a view of promoting efficiency and economy. The Department of Mines proposal is also expected to encounter a strong opposition which is manifesting itself against the creation of new Government departments. The Government reorganization bill which was before Congress at the last session provided for the transfer of the Bureau of Mines from the Interior to the Commerce Department, which has since been accomplished by Executive order. It is therefore assumed that congressional leaders will consider that as far as mining matters are concerned the issue has been settled by this action.

Recent court decisions against war mineral producers will probably result in bills being presented for their relief. These are likely to authorize payment of losses in connection with interest paid on borrowed money and for purchase of property for pro- (*Continued on page* 572)

SCOTT TURNER NEW MINES BUREAU DIRECTOR. METAL AND COAL MINE ENGINEER SELECTED BY THE PRESIDENT.

From a large field of eligibles, President Coolidge, on October 28th, appointed Scott Turner, of Lansing, Michigan, as Director of the Bureau of Mines, succeeding H. Foster Bain, who resigned July 1st. It was said at the White House that Mr. Turner had received a large number of endorsements from prominent men in the mining field.

Mr. Turner is a mining engineer of large and varied experience in mining operations, including both metal and coal, and is 45 years of age, having been born in Lansing on July 31, 1880. His ancestors were early pioneer settlers in Michigan. Upon graduating from the University of Michigan in 1902, Mr. Turner became a field assistant of the Geological Survey. In 1904 and 1905 he was engineer in Arizona for the Development Company of America. He then became superintendent of the San Pablo Gold Mining Company and the Pontiac-Panama Company, in the Province of Veraguas, Panama. In 1906 and 1907 he was a millman for the Hercules Mining Company at Burke, Idaho. He later became assistant editor of "Mining and Scientific Press" in San Francisco. In 1908 Mr. Turner engaged in mining in Alaska. Returning to the United States, he became chief assistant to the mining geologist of the United States Smelting, Refining and Mining Company of Boston. In 1911 he engaged in field work in the tin mines in Cornwall, England, and from 1912 to 1916, he was general manager in Norway and Spitzbergen for the Arctic Company of Boston.

Since that time, Mr. Turner has been engaged in various other mining enterprises in different parts of the United States and abroad. From December 1920 to 1921 he was a consulting engineer of the Bureau of Mines.

Mr. Turner is the author of several technical papers including, "Mining in Panama," "Classification of Igneous Rock" and "The Hercules Mill."

NEW MEXICO'S FUTURE MINERAL PRODUCTION

New Mexico's Future As A Mineral Producer Is Well Established Both In Production Of Metallic And Non-Metallic Minerals—Copper And Coal Lead In The Metallic Class, And The Deposits Of Non-Metallic Minerals Appear To Be Inexhaustible

By E. H. WELLS*

THE future mineral production of New Mexico is worthy of being treated with a large measure of optimism. Certain of her mineral resources, such as salt, gypsum, limestone, building stone, clay, sand, and road materials, are inexhaustible. Known deposits of coal will permit mining to be carried on at a gradually increasing rate for thousands of years. At least a third of the century's supply of copper ore is blocked out.

Many metals and minerals which have been produced or are known to occur in the State will take an important part in future production in spite of the fact that the proven deposits remaining in the ground are not extensive. The list whose future yield is uncertain but quite promising includes alum, arsenic, barite, bismuth, chalk, diatomaceous earth, fluorspar, graphite, iron, lead, lithium, manganese, mica, mineral waters, molybdenum, natural gas, mineral paints, oil shale, petroleum, potash, pyrite, radium, silver, sodium sulphate, sulphur, tripoli, tungsten, turquoise, uranium, vanadium, and zinc. Not only in New Mexico, but throughout the world, the known or blocked-out underground reserve of most of these metals and minerals will suffice only for periods of 10 to 40 years. Additional supplies must come from deposits still undiscovered or undeveloped and from lower grade deposits which are now worthless, but which will become valuable through increased prices or improved and cheaper mining and treatment costs.

Chino Branch of the Ray Consolidated Copper Company at Santa Rita, N. Mex.

The known New Mexico metals and minerals of least future promise are probably antimony, asbestos, various gems, meerschaum, monazite, pumice, and tin.

HYDROCARBONS

New Mexico's most valuable mineral resource promises to be her coal. About 10 percent of the State contains workable coal beds. According to the recent estimates of the United States Geological Survey the total quantity is given as approximately 192 billion tons.

The greatest coal field is the San Juan Basin field, occupying parts of McKinley, San Juan, Rio Arriba, Valencia, Socorro, and Catron Counties, in the northwestern part of the State. It contains 170 billion tons, or 88 percent of the total tonnage. Next in importance is the Raton field, situated chiefly in Colfax County, in the northeastern part of the State, with 16 billion tons of available coal.

The Los Cerrillos field, in Santa Fe County, and the Carthage field, in Socorro County, are being worked actively at present, but their coal reserves are very small compared to the San Juan Basin and the Raton fields.

Although classed as subbituminous, the coal of the San Juan Basin is a very satisfactory fuel. The Raton coal is a high-grade bituminous coal and makes excellent coke. Anthracite coal resulting from the metamorphism of bituminous coal by igneous intrusions has been mined in the Los Cerrillos field. With the exception of some Tertiary coal near the center of the San Juan Basin the coal deposits of the State are Cretaceous.

Coal is New Mexico's most valuable mineral product of the present, and it will probably continue to maintain that position. In 1923 its value at the mines was $10,600,000. During the next few decades the yearly coal tonnage promises to increase gradually. The known anthracite deposits may be depleted in a few years, and most of the bituminous coal will probably be mined long before much of an impression is made on the supply of subbituminous coal. At the present rate of the production a supply for 60,000 years is available.

The most spectacular advance of 1925 among the State's mineral resources has been registered by her oil deposits. The development of the Hogback and Rattlesnake pools in San Juan County, in the northwest corner of the State, during 1922-24 gave definite assurance that New Mexico was destined to become an important oil state. The Artesia field in Eddy County, in the southeast corner of the state, discovered in 1924, has steadily improved until there are now 90 wells in the field, either producing, or capable of producing, oil in quantities ranging from a few barrels to 500 barrels per day. The drilling done has not established the limits of the field. The average daily pipe-line runs of oil for the month of September, 1925, were nearly 4,000 barrels, three-fourths of this coming from the Artesia field and the remainder from the San Juan County fields. The Artesia pipeline production should exceed 5,000 barrels per day before the end of 1925. These figures do not take into account the large amount of oil being used in developing the fields.

The San Juan County oil deposits occur in the Cretaceous Dakota sandstone, and perhaps to some extent in sands just above the Dakota. The oil being produced ranges from 60° to 62° Baumé. It is probably the highest grade oil that has ever been produced in similar quantity in the world. Locally it is used in automobile engines just as it issues from the wells, with fair results. The Artesia oil comes from sand lenses in Permian rocks. Although its average

*President, New Mexico School of Mines; State Geologist.

gravity of 37° Baumé is much less numerically than that of the San Juan oil, it ranks high among the crude oils of the country.

One dry hole does not always prove a structure barren, as has been illustrated at the Table Mesa structure in San Juan County. A recently drilled well, better located than the original test, is reported as a 340-barrel well. Small quantities of 64° Baumé oil have been obtained from shallow sands in wells drilled near Bloomfield in San Juan County.

That additional oil pools will be discovered in New Mexico can be predicted with confidence. The pretentious drilling campaign being carried on throughout the State will result in the testing, and in some instances, the retesting of practically all the known favorable structures before the close of 1926. Many holes are being drilled in the southeastern section, where meager surface data is at least as favorable as it was at the Artesia field. Most of these are certain to be dry, but the returns from another oil pool equal in importance to the Artesia pool will pay for many wildcat wells. Unfortunately, some of the drilling wells in other parts of the State are very poorly located, from a geological standpoint, and have such a small likelihood of finding any valuable quantity of oil that the expense of drilling them is not justified.

The value of oil produced in 1925 promises to be about $2,000,000. This amount should be at least doubled, and possibly tripled, in 1926, and still further increased during a number of succeeding years. Oil is likely to rank third in importance among the State's mineral products during the next decade, but it may for a brief period exceed copper in value, or even displace coal from its position at the head of the list.

At Aztec, in San Juan County, natural gas from two wells near the city is being utilized. Numerous wells drilled for oil in various parts of the State have come in as gas wells. Some of these are capable of yielding 25,000,000 to 75,000,000 cubic feet per day. Because of the scant population and the inaccessibility of most of the regions where it is found the period of utilization of most of the gas developed will not occur for some time. A number of plants for making casing-head gasoline are now in operation, and their number should be substantially increased in the near future.

The Pennsylvania formation near Scholle contains several thin strata of oil shale which is capable of yielding as much as 40 gallons of oil to the ton. Oil shales are reported in the northwestern part of the State. Deposits able to compete with the Colorado, Utah, and Kentucky oil shales have not as yet been located.

Metals

Copper is not only the most important metal obtained from New Mexico mines, but its value is normally much greater than the combined value of all other metals. Since 1923, when 61,000,000 pounds, valued at $9,000,000, was marketed, the copper production has steadily increased. During the present year the State will probably produce nearly 80,000,000 pounds of copper, having a value of over $11,000,000. Unless new large deposits are discovered, the maximum amount of copper produced in any one year during the next quarter of a century will be about 110,000,000 pounds.

The Chino mines of the Ray Consolidated Copper Company at Santa Rita in Grant County will doubtless continue to supply 75 to 90 percent of the copper produced in the State. The Chino ore reserves at the end of 1924 were estimated by the company to be 98,400,000 tons averaging 1.526 percent copper. Next in importance to the Chino copper deposits are those of the Tyrone or Burro Mountain Branch of the Phelps Dodge Corporation, also in Grant County. Here about 7,000,000 tons of ore averaging close to 2.0 percent copper has been developed. At Santa Rita and Tyrone the ore occurs in great low-grade bodies with relatively large horizontal dimensions, which enables prospecting and development work to be prosecuted by churn drilling. The development work of 1925 has located much additional ore of excellent grade at both properties which is not included in the quoted estimates, and promising areas are still unexplored. Although the Chino ore is now being handled by steam shovels in open pits, much deep ore will be mined later by underground methods. All of the Tyrone ore must be obtained by underground mining.

Copper occurs in many other districts in New Mexico, but it is usually in vein deposits or as replacement deposits in the Permian red beds. The Eighty-five mine of the Calumet and Arizona Mining Company is the most promising of the vein mines. It should rank third among New Mexico copper producers of the future. Most of the vein and red bed deposits do not offer much encouragement for an important future production. Grant and Hidalgo Counties are most likely to witness important new copper discoveries.

In 1925 the other common metals besides copper will probably rank in order of their production as follows: Zinc, silver, gold, iron, lead. Zinc alone of this group promises to have a total value for the year of $1,000,000 or more. Moderate increases in production should be registered by zinc in the next decade. The Hanover mines of the Empire Zinc Company in Grant county, which account for almost the entire current zinc output of the state, have sufficient ore broken and developed to maintain the present production rate for some years. Mining of zinc ore is likely to be resumed in the not distant future in the Kelly district of Socorro County by the Ozark Smelting & Mining Company. At present a small tonnage of zinc ore is being produced in the district by lessees.

New Mexico's most important zinc deposits are of igneous metamorphic origin. Geologic conditions are propitious for other profitable zinc deposits near some of the igneous stocks of Grant County, and additional deposits may be discovered in other parts of the state.

As a result of the closing in 1925 of the mines of the Mogollon Mines Company in the Mogollon district, Catron County, the gold and silver production of New Mexico will suffer a decrease for the current year and a further decline in 1926. During the past few years the Mogollon mines have accounted for about 40 per cent of the combined gold and silver production. Unless new deposits are discovered the precious metal output of the future will constitute a relatively unimportant part of New Mexico's mineral production. However, these metals are widely scattered, and new mines may eventually rival the famous old properties which brought New Mexico into prominence as a mining state in the latter part of the nineteenth century.

The recent substantial advance in the price of lead may enable a number of idle lead mines and prospects to join the list of shippers. Lead, like gold and silver, occurs in many sections of the state, but as a rule in only small deposits. Parts of Grant and Hidalgo Counties are particularly worthy of additional prospecting for lead ores. The hope is justified that deposits of much greater importance than any previously worked will be found during future exploratory work.

Mining of iron ore in the past has been handicapped by the high cost of transporting the ore to the nearest smelters. Near Fierro and Hanover in Grant County are immense bodies of igneous metamorphic iron ore awaiting the time when a near-by steel plant will be put in operation. Most of the known deposits are owned by the Hanover Bessmer Iron & Copper Company. At Boston Hill near Silver City, Grant County, 1,000,000 tons or more of high-grade manganiferous iron ore are available. Excellent iron ores of unproved extent occur in a number of other places.

Much uncertainty attaches to the future utilization of the various minor metals found in New Mexico. Proven ore bodies are in all cases lacking or of small extent. The demand for them and the price they bring will probably continue to fluctuate within wide limits. At present the most promising of the metals of this group is molybdenum. The property of the Molybdenum Corporation of America near Questa, Taos County, produced concentrates of molybdenum sulphide having a value of about $30,000 per month during the first half of the year, and a continued production at a corresponding or greater rate for a few years seems probable. Near Dixon in Rio Arriba County lithium ore has been mined in the past few years. Taos and Rio Arriba Counties contain areas characterized by unusual high-temperature veins and pegmatites which in addition to being interesting geologically have commercial possibilities for other constituents besides molybdenum and lithium. Mica obtained near Petaca, Rio Arriba County, comes from these pegmatites. Fergusonite and samarskite, rare earth minerals containing niobium, tantalum, uranium and radium, are found in them.

Manganese deposits are frequently encountered in New Mexico. Those worked in the past have been small and superficial, and no heavy production seems likely in the near future. Tungsten deposits have been worked in a small way or occur in Taos, Lincoln, Grant, Luna, and San Miguel Counties without giving any great amount of hope for large future developments, as have bismuth deposits in the San Andreas Mountains, Otero County, and in Socorro and Dona Ana Counties. Radium, uranium and vanadium may be obtained eventually from carnotite ores in the northwestern part of New Mexico, particularly in the Carriso Mountains, and vanadium from the copper vanadate ores of the central part and from the lead vanadate ores of the southwestern part. Deposits of metals still in the prospective stage include arsenic and antimony in the southwestern part of the state and tin in placers and veins in the Cuchillo Range, Sierra County.

Non-Metals

The future production from New Mexico's inexhaustible deposits of clay, limestone, building stone, sand and gravel will, in general, parallel the growth of the state in population and wealth. Some of the ornamental stones, such as ricolite in Grant County, are unusually beautiful. The total value of this group should shortly exceed $1,000,000 per annum.

The Permian rocks of New Mexico contain a large part of the world's greatest known salt deposits. An area of more than 20,000 miles in the southeastern part of the state is underlain by thick beds of sodium chloride. Drill records in most parts of the area indicate from 200 to 630 feet of salt, but a recently drilled well 3,000 feet deep penetrated an almost uninterrupted salt stratum 1,900 feet thick. Conditions are quite auspicious for the existence in some parts of this immense salt accumulation of potash-rich strata, in which event New Mexico may become an important potash producer. Potash has more interesting possibilities than any undeveloped mineral resource. The Permian strata contain much more gypsum than salt, but because of adverse economic factors its utilization, like that of salt, may be postponed for many years. The gypsum "white sands" of Otero County offer a large tonnage of moderately pure gypsum ready to be loaded into transporting vehicles. Salt will continue to be obtained from deposits at various salt lakes in the state. Lake deposits of sodium sulphate may possibly contribute at some future date to the mineral production. Other sedimentary beds of economic value which have been provided in quantity but whose utilization is less certain are chalk, diatomaceous earth, tripoli and fuller's earth.

Fluorite production in the state has attained in recent years a maximum annual value of $101,000. It is a widely distributed mineral, but the deposits mined have been small and erratic as a rule or have contained too low grade material to be salable without concentration. A moderate increase in the price paid for fluorite would probably enable the state's production to increase sharply. Barite seems to be quite abundant in a number of localities. If its value increases substantially some of the deposits will be worked. The great pyrite deposits of the Chino property of the Ray Consolidated Copper Company constitute an important potential source of sulphuric acid.

The Rio Arriba County mica deposits should continue to be operated and may witness a considerable increase in future activity. Other non-metallic minerals with past production records which should be marketed from time to time are graphite in Colfax County, turquoise in several counties, and sulphur at Jemez Springs, Sandoval County. Some of the state's deposits of mineral paints are reported to be of value. Fairly promising superficial deposits of natural alum in Grant County and elsewhere are apparently prevented from being worked by transportation difficulties.

Asbestos and meerschaum deposits in Grant County hold forth little hope for future utilization, this being true also of monazite in Sierra County and gems of scattered occurrence.

The wonderful artesian wells of the Pecos Valley will continue to furnish irrigating water for thousands of acres. The numerous mineral springs of the state will draw increasing numbers of health seekers, and the demand for their waters as beverages will grow.

BARIUM POLYSULPHIDE AS A SULPHIDIZING REAGENT

THE results of a study of the possibilities of barium polysulphide in sulphidizing oxidized ores for flotation are given in Serial 2698, recently issued by the Bureau of Mines. The sulphidizing filming of minerals in oxide ores as a preliminary treatment to aid their recovery by flotation is known practice, state Edmund S. Leaver, metallurgist, and Horace M. Lawrence, associate metallurgist, the authors.

From the results of the Bureau of Mines investigation it would appear that barium polysulphide has possibilities as a sulphidizing reagent. On the copper ore the extraction and grade of concentrates were about as good as were obtained from any of the sulphidizing reagents used. On the lead ore, however, barium polysulphide did not give as high an extraction as was obtained with a combination of sodium sulphide and polysulphide, or a sodium sulphide-paraffin mixture. Barium polysulphide prepared by either of two methods seemed to have about the same sulphidizing effect.

Of other sulphidizing reagents considered in this investigation sodium sulphide and sodium polysulphide, either separately or as a combination, gave the best results. Calcium polysulphide used alone did not yield as good results as had been expected, as it has been somewhat favored in the past by investigators, partly because of its comparative cheapness. Sodium sulphide and calcium polysulphide as a combination proved to be satisfactory for the copper ore, and at least one of the companies treating oxidized copper ores uses this combination successfully. Potassium and ammonium polysulphides are too expensive for commercial practice, particularly as at least equal or larger amounts of these reagents are needed than is required with the cheaper sulphidizing reagents. In no case in the amounts used did hydrogen sulphide prove to be as satisfactory a sulphidizing reagent as some of the others. Also, as only the amount of gas actually absorbed in water was determined, the total amount of hydrogen sulphide gas generated was much higher. Copies of Serial No. 2698 may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

THE FUTURE OF IDAHO AS A MINERAL PRODUCER

Idaho's Mineral Production Has Reached Magnificent Total Of Approximately A Billion Dollars —Lead Has Been And Will Continue For Many Years To Be Major Mineral Produced— Importance Attached To Non-Metallic Deposits

By FRANCIS A. THOMSON*

THE title above is the editor's, not mine. However, as Mark Twain is reported to have said upon first viewing the Atlantic Ocean, "I approve of it." Furthermore, I believe the American Mining Congress and every other like organization should feature the word "mineral" more and the word "mining" less. Instead of talking about the "mining industry" we should talk about the "mineral industry," for it is a far wider and more comprehensive term. Mineral industry includes, for example, the production of petroleum, the burning of brick, the coking of coal, and even the bottling of mineral water—operations that no one would include under mining as the term is at present used.

IN REVIEW

So far as Idaho is concerned, the mineral industry of the state is older than the state itself; in other words, Capt. Ed. Pierce's discovery in 1860 of placer gold on Orofino Creek in what is now Clearwater County, Idaho, took place while Idaho was still a part of Washington Territory.

From that date until the present Idaho has been conspicuous as a producer of mineral. The placer discoveries of '60 and '61 in North Central Idaho and of '61 and '62 in the Boise Basin led, of course, to the discoveries of vein or lode deposits. First came the finding of the gold and silver mines on War Eagle Mountain, near Silver City, and then of those at Rocky Bar and Atlanta in Elmore County; lead and copper deposits were next found in Lemhi, Custer and Blaine Counties, and finally there came, through the working of placer deposits on the North Fork of Coeur d'Alene River, the discovery of great argentiferous lead-zinc ore bodies on the South Fork of the same river in the now famous area called "the Coeur d'Alenes."

To date the mineral production of the state of Idaho reaches the magnificent total of not far short of a billion dollars.

Although the early day placer production is difficult to determine with any degree of accuracy, owing to the lack of statistics and to the usual halo of romance which is associated with such operations, we can make some fairly reliable approximations, and when we add to the estimated placer production of early days the known lode production of later days, the total reaches close to the figure given above. In tabulated form the estimates would be about as follows:

Central Idaho and Boise Basin (placer gold)	$150,000,000
Coeur d'Alene (lead, silver and zinc)	600,000,000
Other districts (gold, silver, copper, lead)	160,000,000
Estimated total	910,000,000

Wallace, Idaho

IN PRE-VIEW

So much for the past. What of the future?

In the first place, there is no reason to anticipate a further large placer production. Certain limited areas of dredgeable gravel still remain in the Boise Basin, in Central Idaho and in one or two other areas, but it seems improbable that the total production from these will ever exceed the placer production recorded above.

Excluding placer possibilities, the future mineral industry of Idaho can most conveniently be discussed by dividing it under two heads—(1) metallic mineral resources and (2) non-metallic mineral resources.

1. *Metallic Mineral Resources*

It will be noted in the table given at the beginning of this article that practically no production is listed except that of metallic minerals. It must constantly be remembered, also, that a mine is a wasting asset, and that every pound of mineral taken out of a mine depletes to that extent the remaining supply of mineral in the ground. This is a truism often forgotten and it means, of course, that not only most of the placers but also some of the earlier lode deposits have been practically exhausted. To offset this it should be realized that the greater portion of the state of Idaho comprises a "metamorphic aureole" grouped about the great granitic batholith which covers most of Boise, Valley, and Idaho Counties and which crops out also in occasional high points or granitic cupolas to the north, south, east and west of this area. Now it has come to be a generally accepted dictum among metalliferous geologists, that those areas which lie in the roofs of granitic batholiths, or on their peripheries, are likely to be the most productive of the precious and semi-precious metals and are therefore the best prospecting territory. Furthermore, as I have recently pointed out elsewhere,† the conclusion is inescapable that the metalliferous deposits of Idaho comprise a metallogenic province

*Dean, School of Mines, University of Idaho; Secretary, Idaho Bureau of Mines and Geology.

† "Gold Veins of Sundry Areas in the Idaho Batholith," Mining Journal-Press, October 4, 1924, Vol. 118, p. 533.

"Zonal Distribution of Gold, Silver, Lead, and Copper Ores in Idaho." Mining Journal-Press, August 8, 1925, Vol. 120, p. 216.

definitely referable to the batholith and apparently the different metals are in a rough zonation about the granitic outcrops. Hence it is evident that we must consider, in discussing the future of metalliferous mining in Idaho, not only those deposits which have been discovered and are being worked at the present time, but also those which on account of favorable geologic asscciation, it is reasonable to suppose will be discovered in the future. We must also take into account many known and promising deposits which are not being exploited at the present time, on account of their isolation. For it is to be kept in mind that in the central part of Idaho there is a region extending from McCall on the west to Salmon City on the east—a distance of 110 miles, and from Hailey on the south to Grangeville on the north—a distance of 180 miles, in which there is no railroad transportation. In other words, we have within the heart of Idaho an area larger than the states of Vermont and New Hampshire without a foot of railroad track, and practically all of this is potential mineral producing territory.

Lead has for many years been the leading mineral product of the state, the Coeur d'Alene producing from 200 to 400 million pounds each year, according to the state of the market and other conditions. The size, persistence and continuity of certain of the ore-bodies is phenomenal and although individual mines are from time to time exhausted, as is inevitable, other deposits are developed to take their place and only once within the last 21 years has the lead production fallen below the minimum figure mentioned. Furthermore, it seems probable that this production will be maintained for many years. The great Bunker Hill and Sullivan ore-bodies, which have yielded $130,000,000 in lead and silver, appear undiminished in size and richness in the present workings, 3,700 feet below the outcrop, the Hecla ore-body recently opened on the 2,800 level is richer and stronger than it has ever been; and the development of the Star ore-body from the Hecla workings proves that the great Morning lode is continuous for 4,000 feet along the strike and apparently nearly the same length along the dip. Custer, Blaine and Boundary Counties, although far below Shoshone are important lead producers.

Copper. Idaho has never been one of the great copper producers among the western states. Custer and Lemhi are the leading counties, with the known deposits of Adams and Washington Counties as potential producers in the future.

Top, Hecla Mine and Burke Business Section. Center, Bunker Hill and Sullivan Mining and Concentrating Company. Below, Hercules Mill at Wallace

Silver in recent years has been recovered largely as a by-product or incidental to the mining of lead and copper, and the lead producing counties, with the addition of Bonner County, are naturally the leading ones in silver production. This implies that silver and lead production are practically parallel. The recrudescence of such a camp as Silver City in Owyhee County, which seems not improbable, would, of course, alter this situation.

Zinc, like silver, is recovered mainly as a by-product of lead mining operations. With the exception of the period of high metal prices during the war, zinc has not been a profitable metal in the Coeur d'Alene district and many million pounds of zinc have been allowed to go to waste each year. With the development of hydro-metallurgical plants for the recovery of zinc, however, and with the recent entrance of European buyers of zinc ore into the district, this situation is being greatly improved and zinc henceforth will bulk much larger in Coeur d'Alene production.

Gold. In gold the production of Idaho has shown a rather steady decline for 20 years. This is due in part doubtless to the exhaustion of the placers and in part to the lack of stimulation of lode gold production by reason of the fact that although the price of everything else has increased, the price of gold has remained stationary. Vast lodes of low-grade gold ore are known to exist in the central part of the state, however, and as the region becomes more accessible gold production will undoubtedly increase.

Among the minor metals, significant deposits of antimony, molybdenum, tungsten, bismuth, cobalt and quicksilver have been discovered and worked to some extent.

The immediate future of mining, especially in south-central Idaho, has been greatly enhanced by the entry of powerful interests not heretofore interested in Idaho minerals. Henry Ford is carrying on an intensive de-

velopment campaign at the Red Bird, near Clayton; the Boerickes of Philadelphia have taken over the Minnie Moore, an early day producer near Hailey; interests reported to be closely identified with General Motors are developing the Livingston Mine on Railroad Ridge, also near Clayton; and the Homestake interests of South Dakota are reported to have bonded the Meadow Creek property in Yellow Pine for a million dollars. In addition the Bunker Hill and Sullivan, the Day interests, the Federal and other "home" companies are active in the development of new properties, both in the Coeur d'Alene district and in other parts of the state.

2. *Non-Metallic Mineral Deposits*

Although, as noted above, the non-metallic mineral production of Idaho is somewhat insignificant—it is nevertheless probable that in the next two or three hundred years the production of non-metallic minerals will equal if it indeed does not exceed the production of metallic minerals. In order of their known importance at present, I would list the non-metallic mineral resources of the state as follows: Phosphate rock, clay, mica, feldspar, building stone, limestone and other cement making materials, coal with the possibility of oil, and lastly, but not necessarily the least important, mineral water—a substance not usually thought of as a mineral product.

Phosphate. Numerous deposits of calcium tri-phosphate have been proven to exist in the southeast portion of the state, mainly in Bear Lake, Caribou and Bonneville counties. The U. S. Geological Survey estimates that something over five billion tons of phosphate rock have been definitely proven in southeastern Idaho and estimates further that this comprises something like 85 percent of the total phosphate resources of the United States. Professor Kirkham, of our staff, is disposed, in view of recent work which he has done in the area, to increase this estimate to six billion tons or about 85 percent of the total known phosphate resources *of the globe.* At present phosphate production is delayed by competition from the fast disappearing southern phosphate fields and by high transportation costs. Ultimately, however, this great mineral resource is bound to become the basis of an industry of vast proportions.

Clay. The clay resources of the state, especially of Latah and Benewah counties are of great significance. Numerous residual and transported clay deposits derived from the granitic rocks in the eastern portion of these counties have been found to be of exceptionally good grade, suitable for the manufacture of high grade refractories and of porcelains equal to the best English whiteware, when washed and properly prepared.

Mica and *feldspar* are found not far from these clay deposits and mica has been produced on quite a large scale in eastern Latah County.

The *building stone* industry of Idaho is as yet in its infancy. Good sandstone is quarried near Boise; promising marble deposits are know on Clearwater River and in certain parts of Central Idaho there are excellent granites which await only the necessary transportation to make them the basis of a large quarrying industry. Deposits of splendid roofing slate have been found in southeast Idaho.

Cement making implies argillaceous limestones, non-magnesian limestones, and clay deposits. All of these requisites for cement manufacture are known at many points throughout the state and one lime deposit on Pend Oreille Lake is, at the present time, the basis of a large cement manufacturing industry on the outskirts of Spokane.

Coal. Idaho has just one coal mine and that in Teton county, near Driggs. The coal is excellent and of high heat value; it stands, however, in steeply pitching seams, the roof is rather weak and the coal is inclined to be friable. Successful exploitation of the Teton deposits is dependent upon the extra cost of mining in Idaho as balanced against the extra cost of transporting coal from Wyoming and Utah. Ultimately the Teton mines should be able to supply the coal demands of the country between Pocatello, Idaho, and Dillon, Mont.

Oil. No oil production has yet been made in Idaho. However, along the southeastern boundary the oil producing formations of Wyoming and of Montana are known to be present in highly favorable structures and at reasonable depths. Under such conditions, the drilling of favorable structures is undoubtedly justified and until these structures are proven to be barren I shall continue to list petroleum as one of the probable, potential mineral assets of the state.

Mineral springs, both hot and cold, are numerous and widely distributed. Many of them are of proven therapeutic value, and the waters of some are known to be highly radioactive. Doubtless some of these will in time be the basis of notable health resorts.

In thus enumerating briefly the mineral resources of Idaho, it is appropriate to mention that the state government has always been friendly to the mineral industry. Three arms of the state government, the mine inspector's office at Boise, the School of Mines at Moscow, and the Bureau of Mines and Geology also at Moscow, are at the services of all persons interested in mineral development. Repressive blue-sky laws are absent from the statute books and the agricultural interests of the state have so far been sufficiently awake to their own interests to avoid laying an oppressive burden of taxation upon the mineral industry.

Surface Plant, American Phosphate Corporation, East of Montpelier in Bear Lake County, Idaho

PRODUCTION OF STEEL BY DIRECT PROCESSES

THE Bureau of Mines has for some time been working on the problem of sponge iron production by several promising methods. This work, which was being conducted at the North-West Experiment Station, Seattle, Wash., was, at the beginning of the present fiscal year, transferred to the North-Central Experiment Station, Minneapolis, Minn. In the laboratories of the Minneapolis station work has been conducted during the past year on the factors affecting the time rate of iron ore reduction. The results of these experiments are applicable to the sponge iron investigation and will therefore be continued, giving the station a means of interpreting scientifically the results obtained in the sponge iron experiments.

A number of other investigations on the metallization of iron ore and on the production of sponge iron are being carried on. Thought has been given to outlining the future work of the Bureau of Mines along these lines in such a manner that it may best fit in with the problem of production of steel by direct process considered as a whole. Attention has also been given to the best methods of utilizing the products from the metallizing process and to the economics of these processes with respect to the utilization of low-grade iron ore.

The first section of the U. S. Coal Commission reports, covering legislative recommendations of the commission, are now available.

Mason Valley Mines Company, 1,000 tons per day flotation mill

THE FUTURE OF NEVADA AS A MINERAL PRODUCER

Nevada Will Be A Substantial Producer Of Metals For Many Years To Come And Its Future As A Producer Of Non-Metallic Minerals Is Assured, Due To Large Deposits And Great Variety Of These Materials

By JOHN A. FULTON* and WALTER S. PALMER†

NEVADA as a mineral producer needs no introduction to the public; in fact, Nevada is synonymous with mining in the minds of most Americans.

The years of maximum production were 1878 and 1917. The 1878 peak was made up of $47,676,863 gold and silver, and $2,242,750 lead, a grand total of $49,919,613. These were the only commercial products being produced. The Comstock Lode and Eureka District were the main contributors.

The 1917 peak was made up of $16,170,200 gold and silver, $33,522,954 copper, $2,380,302 lead, $2,275,402 zinc, $886,630 from the following: Tungsten, antimony, mercury, platinum, palladium, iron, molybdenum, manganese, ferro manganese, sand and gravel, stone, lime, diatomaceous earth, pebbles, salt, clays, gypsum, graphite, sulphur, mineral waters, and precious stones; the total value for 1917 was $55,235,488 and was, of course, due to the war. It is interesting to note that the 1878 production came from but three substances, whereas the 1917 production comprises about 30.

The total gold and silver from Nevada amounts to almost 950 millions of dollars. The present yearly production is around 12 millions. Some new camps are developing, many of the old districts are coming back and the consistent producers still have many years life ahead of them. As time goes on the best opinions are that important new discoveries will be made, so that it is safe to say that Nevada will continue to contribute substantially to the gold and silver production for a long time to come.

The copper output reached its peak in 1917 with $33,522,954, the output is now down to $10,000,000 yearly, which can be maintained. The Nevada Consolidated is the heaviest producer, and practically the only one, but with the completion of the railroad from Rogerson, Idaho, to Wells, Nev., the Contact region will be economically accessible and will produce; the Mason Valley Mines Company have spent substantial sums on their mines and plants to get ready to resume operations, the copper output will undoubtedly increase over the present scale of production.

The possibility of further important new discoveries of copper ores in new areas is problematical, but some of the known districts will be developed and operated as time goes on.

The lead production reached its peak in 1878 with 31,063 short tons, but it was only worth 3.61 cents per pound. Heavy production continued, gradually getting less until 1891, when it was down to 1,500 short tons. Since that date the state has produced several thousand tons annually and will continue to keep up its average production consistently. Possibility of developing new ore bodies in the old mines is always present and new discoveries may be made, but Nevada probably never will be a great lead state again.

The zinc production has never been heavy and it is very doubtful if it ever will be.

Tungsten deposits have been actively worked due to the war stimulus and several mines are again operating due to the influence of the tariff on tungsten in ore. There are several known deposits, and given an adequate price they can and will continue to produce.

Platinum and palladium are recovered from the Ely Copper ores. The Boss mine at Goodsprings has produced somewhat and low grade ore near Bunkerville in Clark County has possibilities.

Tin has been found in the Majuba Hills northwest of Imlay in a volcanic rock, also northeast of Battle Mountain in narrow seams of rhyolite, but thus far no commercial deposits have been discovered.

Mercury has been produced from many different places, but the future possibilities are not encouraging, although a small output may be expected from time to time.

Iron deposits in the form of magnetite occur at numerous places; some of these are very pure, but are not commercial ores on account of the distance from large centers.

Antimony, arsenic, bismuth, vanadium, nickel, etc., also occur and some production has been made, but with normal prices the deposits are not commercial.

From the foregoing it can be seen that Nevada will be a substantial producer of metals for many years to come, but what is not realized by the country at large is the possibility of non-metallic production of industrial materials of a great variety. The Mackay School of Mines is training its students in this branch of mining, and the state government, through Governor Scrugham, is fostering this branch of the industry to the greatest possible extent; the railroad companies are also cooperating in every way possible.

Professor Palmer, of the Mackay School of Mines, has prepared some notes on the non-metallics which cover the field fully, and which are a part of this paper.

NON-METALLICS IN NEVADA

Nevada, long noted as a state in which mining of gold, silver, lead, copper and other metals has been a leading industry,

*Director, Mackay School of Mines.

†Professor of Metallurgy, Mackay School of Mines.

now shows promise of becoming a very important producer of non-metallics. Raymond B. Ladoo in his recent book, "Non-Metallic Minerals," lists in the table of contents 87 non-metallic minerals of commercial importance. Not less than 56 of these are to be found in Nevada. In the "Mineral Industry" there are listed 46 mineral substances or groups of minerals, and of these, representatives of all but five of the groups are to be found in this state.

Gypsum

There are a number of large deposits of gypsum in Nevada. Some of them are of exceptional purity and of sufficient size to last for many years. The more favorably situated deposits at the present time are those at Gerlach and Ludwig in the western part of the state and those at Arden and Moapa in the southeast corner of the state. Plants are at present operating at all of these points. The plant at Gerlach is the largest west of the Mississippi River and contains the very latest in the way of plant equipment. This property is operated by the Pacific Portland Cement Company, and was placed in operation a little over a year ago. Several other deposits have been described in reports of the Geological Survey, but at the present time they are not favorably located with respect to transportation. There are, however, other deposits in the vicinity of those now being worked which are not developed. Although fuel and transportation costs are rather high, and the local demand small, the mills of the state can compete successfully with other Pacific Coast plants because of the high quality of the products. This industry has expanded to some extent and with increased development and building in California it has a good future before it, with a supply of raw material sufficient for the next generation as well as this.

Clay and Bentonite

Several kinds of clay are found in Nevada. Pottery clay of fair grade has been reported from Churchill County. This county also produces a clay which has been found suitable for use in deinking of news print and regular shipments are being made to plants in California. In the southern part of the state several deposits of clay suitable for use in decolorizing oil have been found and several of the large oil companies have taken up deposits. Brick clay has been produced from several points, but mainly from deposits at Reno where some of the best common brick on the coast are produced. Fire clay is reported from Ormsby County.

Clay of the variety of bentonite has recently been attracting much attention. Clays of this type are found in several parts of the state and at one time there was an attempt made to market the material as "mineral soap."

The Mackay School of Mines, in conjunction with the Reno Station of the Bureau of Mines, is conducting a comprehensive study of bentonite.

Salines

Borax was produced in Nevada prior to 1870. The early borax produced came from the so-called "marsh deposits." These deposits were found in the southern and western parts of the state. After the finding of rich colemanite deposits near Death Valley the production of borax from the marsh deposits entirely ceased. Recent discoveries of very rich colemanite deposits in Clark County has again brought Nevada into the ranks of producers of borax. Further prospecting will probably result in the finding of other valuable colemanite deposits in the southern part of the state.

Sodium chloride or common salt is found and has been produced in many parts of the state from the marsh deposits. At one time it was extensively used in the silver mills of the state, but with the introduction of the cyanide process this market declined to practically nothing. Most of the salt now used in the state, except in some local districts, comes from Utah or California. Probably the largest deposits in the state are along the Virgin River near St. Thomas. H. S. Gale has reported these deposits as occurring in ledges along the river for over 12 miles, and in one place there is a solid, almost vertical wall of crystalline salt exposed which is 100 feet high, the bottom of which is not exposed. Some of the salt crystals 8 and 10 inches in diameter are transparent. The deposits are entirely undeveloped at the present time.

Sodium sulphate is found in a number of different places in the state. The largest deposit is located near Wabuska and is reported by a geologist of the Southern Pacific Company as being probably the largest deposit of this mineral in the United States. Other large deposits are found in Lyon and Eureka Counties quite near the railroad lines. Several other smaller deposits occur in several of the desert basins.

Potash is found extensively over the state in desert brines and this led to extensive prospecting during the war period, but no commercial deposits were found. The Western Chemical Company have erected a plant to extract potash alum from a deposit in the Alum District in Esmeralda County. Some deposits of alunite have also been found in the state which may at some future time prove valuable as a source of potash.

Natural soda has been found in several deposits in the state, but at present none of them are being worked.

Building Stone

Stone suitable for building and other commercial purposes occur in many parts of the state and have been quarried to some extent. Up to the present time the rocks quarried consist of granite, andesite, sandstone, rhyolite, volcanic tuffs and marble.

Marble has been produced from several localities in the state; the largest quarries are those of the American Carrara Marble Company in Nye County. Some marble has been quarried in Mineral County. Other deposits of workable material occur in Elko, White Pine, Lyon and Pershing Counties.

A silicified rhyolite has been mined near Manhattan for use as grinding pebbles in tube mills.

All of the sand and gravel used in Portland cement concrete for construction purposes in the state comes from various deposits in the state.

Paint Pigments

Deposits of mineral substances suitable for use in paints are found in many parts of the state.

Amorphous graphite is mined near Carson and other deposits occur about 10 miles west of Reno. Smaller deposits are found in Lyon, Pershing and Mineral Counties.

Yellow ocher is found in several places in the state in sufficient amount to be of commercial value. One deposit is situated near Eureka while another is in Esmeralda County. This latter deposit also contains red iron oxide which is at present being marketed. The deposit is estimated to contain several million tons. A deposit in Lander County is said to be a very fine deposit and to contain red and yellow bases for 27 different colors. Other smaller deposits are found in the state.

Barite

Barite, which is used extensively in paints, is found in many places in the state. It has been shipped from the following counties: Churchill, Clark, Esmeralda, Mineral and White Pine. The production could easily be increased if there was an increased demand for the mineral.

Silica

Silica is found in many forms throughout the state. The most extensive deposits are those in which it occurs in the form of dia- (*Continued on page* 569)

UTAH'S MINERAL FUTURE

One Hundred And Eighty-three Useful Minerals Are Found In Utah—State's Future As A Mineral Producer Rests Largely Upon World Requirements For These Materials

By A. G. MACKENZIE*

UTAH'S future as a mineral producer will be determined largely by the world's requirements of the minerals Utah produces and the extent to which other mineralized areas will contribute to fill those requirements. Many of the most important minerals exist in Utah in great quantity and the state has an exceptional variety of them. The U. S. Geological Survey lists 183 separate minerals under "Utah" in the Survey publication, "Useful Minerals of the United States."

Some of these are already produced in quantity. The state is among the leaders in the production of gold, silver, copper, lead, zinc and coal. It has an iron industry already in production and with unmeasured iron ore deposits to supply its expansion. It has a considerable production from its hydro-carbons, but the production is inconsequential in comparison with the billions of tons of hydro-carbon deposits in the state, and there are also billions of tons of oil shale. It has sulphur, aluminum, antimony, arsenic, bismuth, graphite, phosphate, potash, ornamental and building stone, lime, cement, clays, salt, pumice, quicksilver, slate, silica sand, gypsum, mineral earths, paints and waters, natural gas, many of the so-called rare minerals, such as tungsten, manganese, vanadium, uranium and molybdenum, and several varieties of semi-precious gems. Although Utah can not as yet claim importance as a producer of crude petroleum, considerable and sustained oil prospecting has been done by responsible organizations and a slight commercial production indicates that it may also take a place as an oil state.

The foregoing is only a partial list of the mineral resources proved by actual operations to exist in quantity within the state. Some of these minerals are of comparatively recent discovery, a fact which suggests that many others may be disclosed through future investigation.

It is demonstrable by physical conditions that some of these mineral deposits are of vast extent and sufficient to assure operations for indefinite periods. It is interesting to note also in connection with consideration of the permanence of the mineral industry of Utah that in instances where reserves can not be accurately measured or estimated in their entirety, experience has shown exceptional persistence in volume and value. As illustrative of this, several of the oldest and most productive metal mines are said today to have greater known ore reserves of good quality than at any time in their history.

The diversity of Utah's mineral industry is another indication of its permanence. Like the state's agricultural industry, its products are so varied that some branch of it is in the enjoyment of a fair measure of prosperity at all times. Such a situation naturally encourages investment, stimulates development and induces continued operation. Markets are growing steadily, especially for those mineral products that formerly were restricted in sale by distance from consumers but now share the advantages that come with the rapidly increasing population and development of the western states.

U. S. Bureau of Mines photo
Tintic Standard Mining Co., Eureka, Utah

*Secretary, Utah Chapter American Mining Congress.

CALIFORNIA'S MINERAL INDUSTRIES IN 1924

Production For 1924 Shows An Increase In Value Of More Than Thirty Million Dollars Over 1923

COMPILATION of the final returns from the mineral producers of California for 1924 by the statistical division of the State Mining Bureau, under the direction of Lloyd L. Root, State Mineralogist, shows the total value for the year to have been $374,620,789, being an increase of $30,596,111 over the 1923 total of $344,024,678. There were 60 different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the 58 counties of the state contributed to the list.

As revealed by the data following herein, the salient features of 1924 compared with the preceding year were: The increased value of the petroleum yield, although there was a material decrease in quantity; decrease in cement value owing to lower prices, although increased amounts were manufactured; increases in copper, quicksilver, tungsten, granite, marble, miscellaneous stone, limestone, mineral water, potash, and salt; and decreases in natural gas, gold, silver, platinum, brick, magnesite, pottery clay, gypsum, pyrites, and borates. The net result was an increase in the grand total of all groups of nearly $31,000,000, as stated above. Petroleum accounted for an increase of $31,921,565 in total value in spite of a decrease of approximately 34,000,000 barrels in quantity.

Of the metals: copper increased from 28,346,860 pounds, worth $4,166,989, to 52,089,349 pounds, worth $6,823,704; quicksilver from 5,458 flasks and $332,851 to 7,948 flasks and $543,080; and tungsten from 34 tons and $19,126 to 781 tons and $446,009. Gold decreased slightly from $13,379,013 to $13,150,175, in spite of which, as for several years past, California continued to account for approximately 30 percent of the gold output of the United States. Silver decreased in value from $2,918,743 to $2,381,952, owing to a lower average price.

Of the structural group: cement advanced in quantity from 10,825,405 barrels to 11,655,131 barrels, but due to foreign importations duty free, the price dropped, resulting in a decrease of total value from $25,999,203 to $23,225,850; granite increased from $760,081 to $1,211,046 in value, due to certain large building contracts, notably the Los Angeles County Building; brick and hollow building blocks or tile decreased in total value from $9,738,082 to $9,137,908 owing mainly to a decrease in common brick. Lime and magnesite also registered decreases.

THE DEVELOPMENT OF ARIZONA'S MINING COLLEGE

An Outline Of The Development Of Arizona's College of Mines—The Work It Has Done And Is Equipped To Do—Mining Men Have Given Splendid Cooperation And Support

By G. M. BUTLER*

IT is natural that the University of Arizona, situated, as it is, in a region with very valuable mineral resources, should, from the first, have given much attention to mining. In fact, in the Old Main Building, the first structure erected on the campus, there is a large marble tablet inscribed:

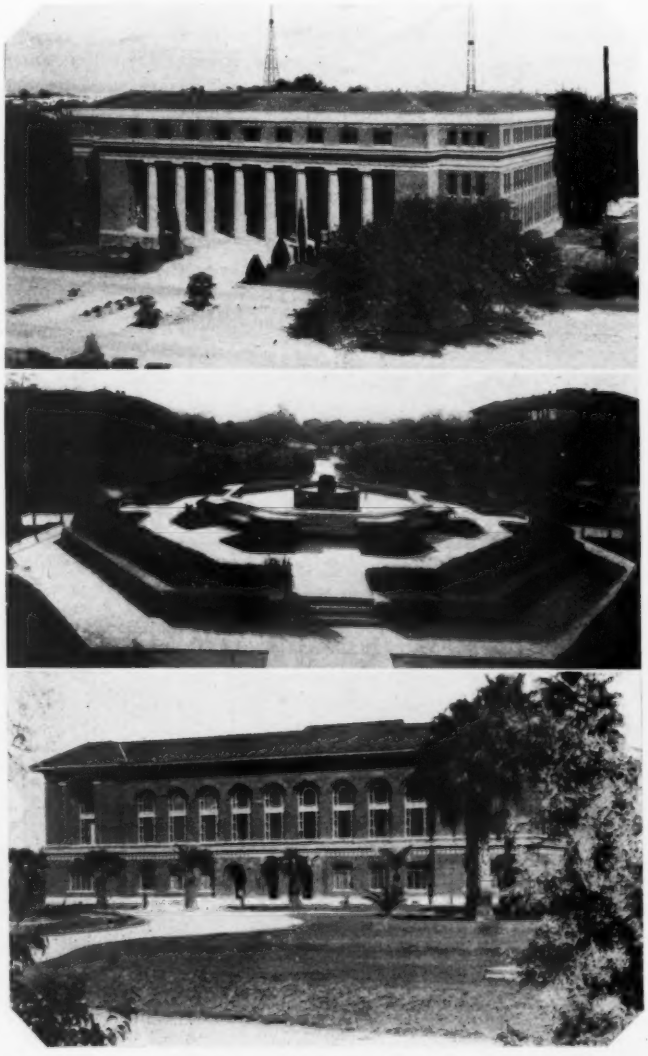
School of Mines of the University of Arizona, Erected A. D. 1888

Furthermore, the only schools that had been established in the institution when it opened its doors to students in 1891 were those of Mines and of Agriculture. At that time there was not a high school in the State, and only nine of the thirty-one students who then registered were prepared to take college work. Indeed, for many years more students were enrolled for preparatory than for collegiate work, and it was not until 1915 that the preparatory department was established. That year, a mere decade ago, really marks the beginning of the period of rapid growth and great expansion that has resulted in the development of the great institution of which the residents of Arizona are so proud.

During the preceding 24 years the small graduating classes rarely failed to contain one or more men who had completed the course in mining engineering; and among those early graduates of the University, who have risen to positions of some prominence in their profession, are: T. E. Steele, Chief Chemist and Metallurgist, Pittsmont Smelter Co., Butte, Mont.; Hugh M. Wolflin, formerly Superintendent of the Industrial Accident Commission of California; Dr. Wm. A. Tarr, Professor of Geology, University of Missouri; Arthur Perry Thompson, Consulting Mining Geologist, Oakland, Calif.; M. L. Hartman, Director, Research Laboratory, Carborundum Co., Niagara Falls, N. Y.; H. W. Lusk, Chief Chemist, C. & A. Smelter, Douglas; and many others.

During this early period an average of less than three men each year taught all branches of geology, mineralogy, metallurgy, and mining engineering proper; and frequently they were called upon to handle other subjects, especially chemistry. Besides a small faculty, the institution was handicapped by limited equipment and inadequate quarters. The fact that such satisfactory results were obtained must be attributed to the environment and to the personality and ability of the early teachers, among whom were Dr. W. P. Blake, Dr. C. F. Tolman, Dr. C. H. Clapp, Dr. F. N. Guild, and C. E. Van Barneveld.

When the preparatory department was abolished ten years ago the University became an institution of three Colleges and several Schools, and the Arizona School of Mines has since been known as the College of Mines and Engineering. The writer came to the University in 1915 as the first Dean of this College, so feels qualified to draw comparisons between the College of ten years ago and today. It is doubtful if any college in the country can show such a record of development in the same length of time.



Above, College of Mines and Engineering Building, University of Arizona. Center, Memorial Fountain. Below, University Library

Ten years ago the classes in engineering, metallurgy, and geology were scattered all over the campus in unsuitable and inadequate quarters. The College faculty numbered eight men, and the enrollment was about 50. Practically all of the students were graduates of Arizona high schools; and the college was hardly known outside of the state. The equipment was meager and the salary scale was so low that few good men could be attracted to the school or retained after their ability was demonstrated. Three men taught all of the mining, metallurgical, geological, and mineralogical subjects offered. One of these men was also Director of the Arizona Bureau of Mines, while another was head of the Chemical Department. Crowded teaching schedules were necessarily the rule, no specialization was possible, and very little time was available for research.

Now the work of the college is practically all done in the splendid three-story-and-basement Mines and Engineering Building and in the Mechanic Arts Building, which houses all the

*Dean, College of Mines and Engineering, and Director, Arizona Bureau of Mines, University of Arizona.

shops. The college faculty (including only those men who are under the administrative supervision of the Dean, and not the teachers of English, chemistry, economics, mathematics, physics, etc.) numbers twenty-one people, while the enrollment this year will be close to three hundred. Twenty-seven percent of the students in the College are from outside of Arizona, while fifty-five percent of the mining students are from outside of the State. Five foreign countries, and twenty-six States are represented upon the College roster. These figures prove that the institution is widely and favorably known outside of Arizona. The equipment for ore dressing, metallography, mineralogy, and mining is unsurpassed anywhere, and the electrical engineering, civil engineering, and mechanical engineering laboratories and shops will compare very favorably with the facilities of much older and larger institutions. The average salary paid instructors has about doubled, and the maximum salary obtainable is such as has made it possible to attract and retain men of international reputation, such as Dr. F. L. Ransome, Dr. A. A. Stoyanow, Dr. Chas. Schuchert, etc. Now eight men devote all of their time to teaching and research in mining, metallurgy, geology, and mineralogy, while five others teach part of their time in the same departments. Seven of these men hold doctorates, while three others have earned masters' or professional degrees. Each branch of the subjects just mentioned is now taught by a specialist who has relatively light teaching schedule and enjoys leisure for research work which must vitalize his courses and make them much more interesting. Besides the members of the teaching faculty, two men are employed on a full-time basis for research work only.

The extremely satisfactory conditions that now prevail in Arizona's mining college are, naturally, very largely attributable to the President of the University, Dr. C. H. Marvin, and the members of the Board of Regents. Not only have they publicly announced their determination to build up in Arizona the best mining college in the country by providing the best equipment obtainable and the best teachers available, but they are furnishing such funds and have in every way in their power shown such an intense interest in furthering the work of the college that many competent and unprejudiced mining men have expressed the opinion that the goal sought has already been won.

The determination to attain preeminence and the expenditure of ample funds, are however, not alone sufficient to explain the unique success of Arizona's mining college. The rapid development of the institution is doubtless very largely due to certain peculiarly favorable conditions which prevail at Tucson, namely:

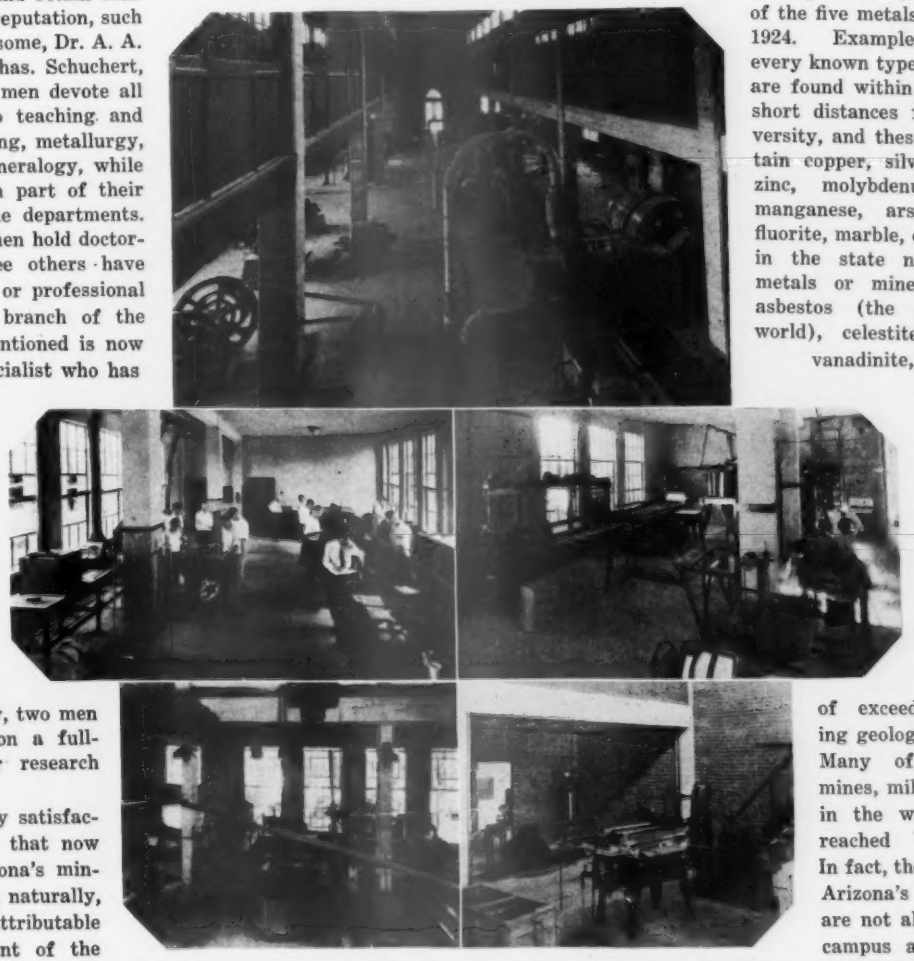
1. *The environment is almost ideal for the development of such a school.* Tucson is the geographic center of one of the best mineralized areas in the world; Arizona is preeminently a mining State—the greatest producer of metals in the Union. The mineral industries pay directly over half and directly and indirectly about two-thirds of all the taxes collected in the State. The total value of the mineral production since the Gadsden Purchase is over $1,600,000,000, and is distributed among the various metals and minerals approximately as follows:

Copper	$1,289,000,000
Silver	150,000,000
Gold	172,500,000
Lead	13,270,000
Zinc	6,594,000

Other metals and minerals, $3,000,000.

In a single year the value of copper, gold, silver, lead, and zinc produced in Arizona has reached nearly $220,000,000, while the average recent yearly production of these metals is at least a hundred million dollars. The dividends paid by the mines have aggregated over four hundred million dollars. The mines of Pima County, in which Tucson is situated, produced $9,215,229 worth of the five metals mentioned, in 1924. Examples of almost every known type of ore deposit are found within comparatively short distances from the University, and these deposits contain copper, silver, gold, lead, zinc, molybdenum, tungsten, manganese, arsenic, gypsum, fluorite, marble, etc. Elsewhere in the state not only these metals or minerals, but also asbestos (the finest in the world), celestite, strontianite, vanadinite, cinnabar, several gem minerals, Mexican onyx, etc., have been produced.

The semi-arid climate and the bold relief of the region make it easy to find and study examples of a great variety of exceedingly interesting geological phenomena. Many of the greatest mines, mills, and smelters in the world are easily reached by automobile. In fact, the laboratories of Arizona's mining college are not all located on the campus at Tucson. The whole State of Arizona is a great mining and geological laboratory, and the value of the theoretical



Above, Mechanical and Hydraulic Laboratory, University of Arizona. Center, left, Assaying Laboratory; right, Small Scale Ore Dressing Laboratory. Below, left, Part of Large Scale Ore Dressing Laboratory. Right, A Corner of the Mining Laboratory

and experimental work of the mining course is greatly increased by frequent trips, made in University-owned busses, to points where the practical operation and development of great enterprises and unique geological features may be observed.

It is probably impossible to over-emphasize the influence of the environment upon the development of the College. The situation and atmosphere are certainly stimulating to mining students. Continually they hear and read about mining, so are early impressed with the importance, the dignity, and the responsibility of their chosen profession.

2. *The great mineral industries of the Southwest cooperate closely and actively with the College.* The interest and support of the mining men is, in fact, one of the most valuable of the institution's assets. Because of this interest, it is possible to guarantee summer work, such as will give the students splendid experience, to all who prove worthy, and inspection trips may be taken at any time with the assurance that the boys will be cordially welcomed. Last year the mining students listened to from one to three lectures delivered by each of the following officials, who expressed their entire willingness to cooperate with the College in this way:

Arthur Crowfoot, Concentrator Superintendent, Morenci Branch, Phelps Dodge Corp.; Val De Camp, Superintendent, United Verde Copper Co.; W. G. McBride, General Manager, Old Dominion Co.; Dr. G. J. Mitchell, Chief Geologist, Cananea Consolidated Copper Co.; D. M. Rait, Mine Superintendent, Calumet & Arizona Mining Co.; Dr. Louis Reber, Chief Geologist, United Verde Copper Co.; J. M. Samuel, Head of the Investigation Dept., Copper Queen Branch, Phelps Dodge Corp.; and Gerald Sherman, Consulting Engineer, Phelps Dodge Corp.

The plan of arranging to have administrators, engineers, and scientists connected with the mineral industries deliver lectures is to be continued this year, since, not only did the students derive much benefit from the addresses, but the interest of the visitors in the College was stimulated, and they offered many valuable suggestions relative to the curriculum, etc. Largely as a result of the conferences held with the gentlemen just named, a unique graduate course in mine administration, which involves the cooperation of the Arizona mining companies to an unusual degree, will probably be announced this year.

In order to acknowledge the cooperation and support extended by mining men to the College during the last few years it would be necessary to mention nearly every mine official in the Southwest; but, in addition to the eight gentlemen who addressed the mining students last winter, the institution is indebted for favors extended during the past year to Frank Ayer, Manager, Moctezuma Copper Company; C. L. Bartholmew, Superintendent, Verde Central Mines; Captain H. A. Clark, Smelter Superintendent, Calumet and Arizona Mining Company; G. F. Coope, Chief Engineer, New Cornelia Copper Company; Michael Curley, Manager, New Cornelia Copper Company; E. G. Deane, Manager, Superior and Boston Copper Company; W. L. DuMoulin, Assistant General Superintendent, New Cornelia Copper Company; F. H. Hayes, Mine Superintendent, Copper Queen Branch, Phelps Dodge Corporation; Captain J. P. Hodgson, Manager, Morenci Branch, Phelps Dodge Corporation; William Koerner, General Manager, Magma Copper Company; H. W. Lusk, Chief Chemist, Calumet and Arizona Mining Company; F. W. Maclennan, General Manager, Miami Copper Company; William Plaisted, Chief Engineer, Inspiration Consolidated Copper Company; E. E. Whiteley, Manager, Calumet and Arizona Mining Company; Percy Williams, Manager, El Tiro Copper Company; F. A. Woodward, General Manager, Iron Cap Copper Company, and others.

G. M. Butler, Dean of the Mining School, University of Arizona
The success of the Arizona Mining School is quite largely a result of the ability and personality of Dean Butler

3. *The College is an integral part of the State University.* This fact makes it possible for the students to elect courses that are not available in schools teaching only mining engineering; and such nontechnical courses are offered by large departments that contain specialists of distinction. Furthermore, the non-mining technical departments in which mining students must take work, such as mathematics, chemistry, physics, geology, and various branches of engineering, are naturally better equipped and manned than in a school that offers only mining degrees, since in the University of Arizona such departments grant undergraduate and even graduate degrees.

The standards, equipment, personnel, and resources of the University are so fine that the institution has been admitted to full membership in the Association of American Universities, and has been ranked "Class A Without Restrictions" by the University of Illinois. The ratings of this institution are generally recognized as authoritative. Furthermore, the War Department classes the University as a "Distinguished Institution."

4. *The enrollment in the mining course is small as compared with some similar schools, and the faculty is relatively large.* These facts make it possible for instructors to give the students all the individual instruction and help they may need.

The mining college long ago adopted, and is firmly adhering to, the motto, "Quality rather than quantity." It does practically no advertising, offers no free scholarships (except a few teaching and research fellowships open to graduate students), and has always regarded mere size as a handicap.

Such, then, are in part the reasons why Arizona's mining college has made such remarkable progress in the last few years and has attracted the favorable attention of mining men all over the world. Its development is not surprising since, with such facilities and support, and in such an environment the attainment of preeminence can hardly be avoided. It may not yet have reached the goal that it has set for itself, and it is to be hoped that it will always have something in view for which to strive, but that goal appears to be in sight; and its reputation as a mining school of the highest grade is firmly established among mining men who are familiar with its work and aims.

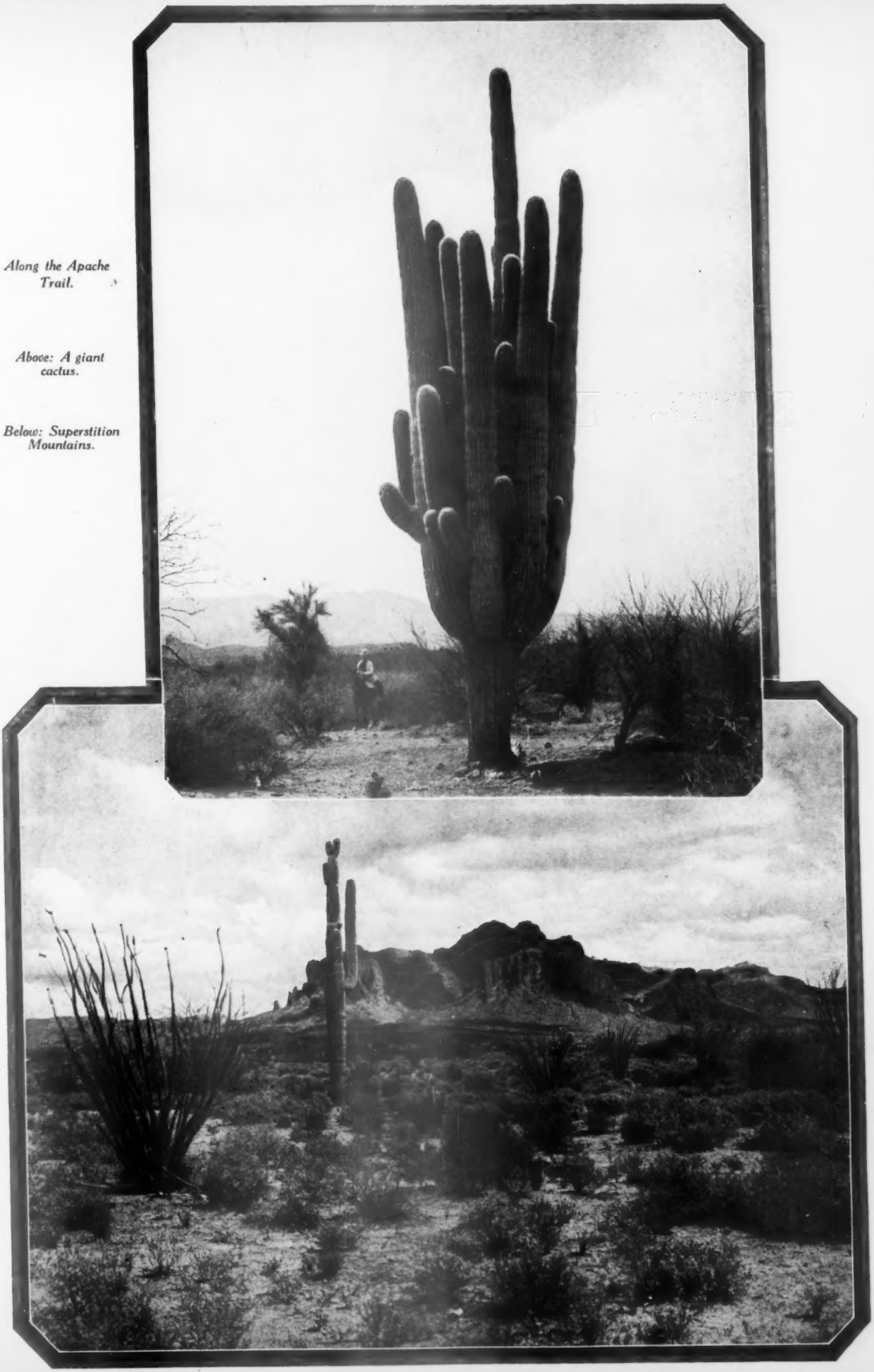
MINE SAFETY STUDIES

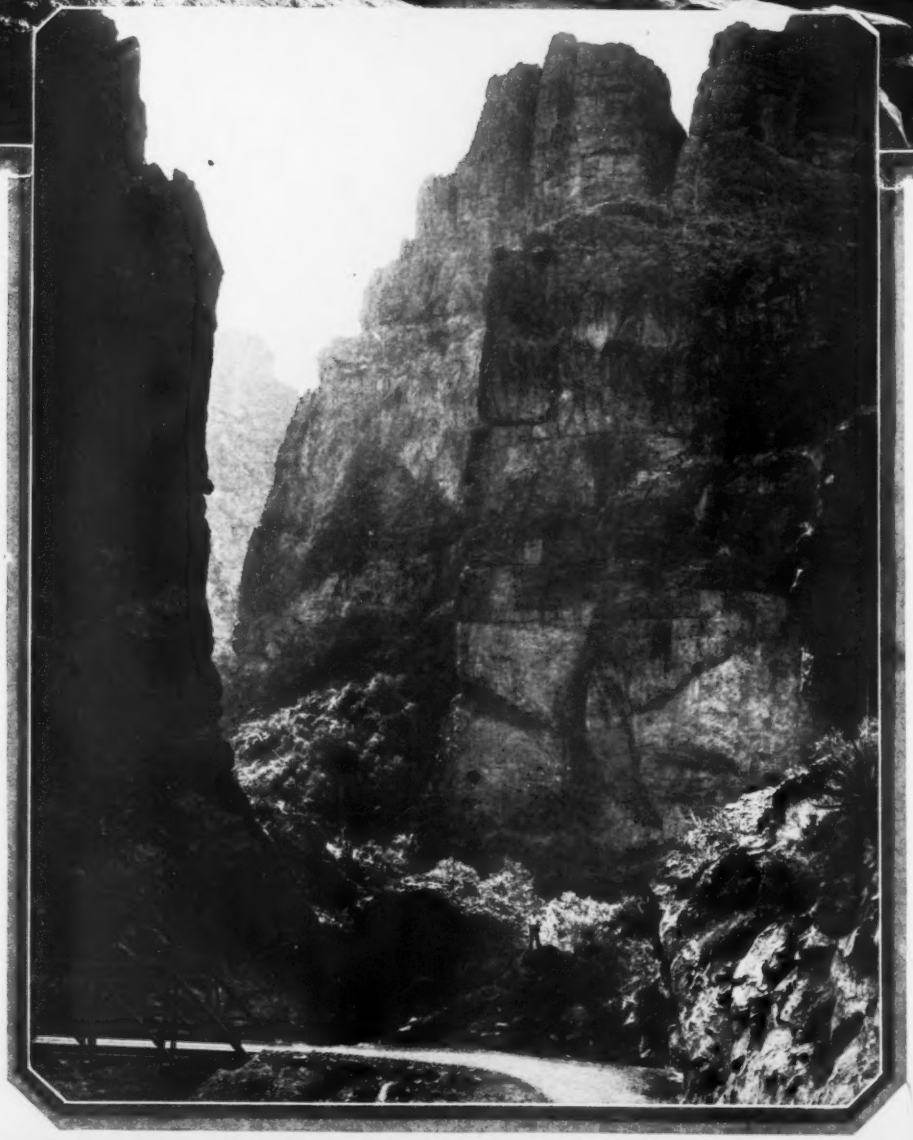
The Bureau of Mines is planning investigations into causes of accidents by falls of roof and coal, in cooperation with the mining department of West Virginia Department of Mines. State Mine Inspector R. M. Lambie and the Bureau of Mines will detail investigators who will conduct tests in West Virginia mines with a view of decreasing accidents of this character. According to officials of the bureau, strength of roof and timbering is not the only factor involved, but details of mining methods and administration enter into the situation.

Along the Apache Trail.

Above: A giant cactus.

Below: Superstition Mountains.





Along the Apache Trail.

Above: Tonto cliff dwellings.

Below: Looking up Fish Creek Canyon.

PROSPECTING FOR MINERALS IN ARIZONA

Arizona Mining Men Suggest Modification In 50-Year Code—Senators From Arizona Sympathetic Toward Mine Leaders—Congressional Committee Hears Views

PROBLEMS encountered by Arizona mining men in prospecting for minerals and developing mining properties were recently laid before a subcommittee of the Senate Public Lands Committee. This body has been investigating the entire public domain question during the congressional recess and expects to submit its report to the Senate next December.

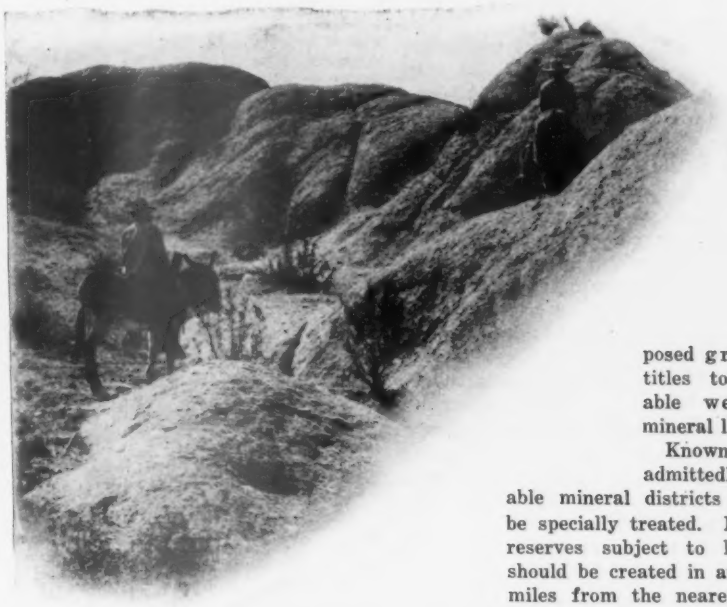
The inquiry was authorized upon a resolution introduced by Senator Cameron, of Arizona, and he and Senator Ashurst, of Arizona, are members of the subcommittee which recently conducted hearings in that State. The purpose was to enable mining men and others interested in land matters to submit their views on present conditions without subjecting them to the inconvenience of appearing before the committee at Washington.

Both Arizona Senators manifested a deep interest in the welfare of the mining industry and those engaged in its development. Senator Cameron had previously introduced a bill in the Senate to permit the patenting of mineral lands in concentrated deposits, and sought the views of Arizona mining men on this proposed legislation. From observations made by both Senators during the hearings, it is very probably they will recommend new mining legislation to meet existing conditions incident to mining. In addition to the Arizona hearings the committee has held, or will hold, meetings in practically every western State.

Senator Ashurst referred to the "burdens under which the miners are laboring." He said "the prospector in Arizona, instead of being treated as a citizen of dignity, instead of having a badge of honor pinned on him, has, by some of the bureaus of our Government, been treated as an object of suspicion and contempt."

"We," said the Senator, referring to the committee, "assure the miners and prospectors that we regard them as citizens of dignity and importance in the life of this Republic."

H. A. Smith, representing prospectors, miners and claim owners of the Warren district, criticized what he alleged was the vicious policy of eighteen years standing of officials of the Interior Department, which he said had destroyed development of valuable ore areas. He said the department in 1907 stopped issuing mining claim patents in the district. Suits to cancel existing claims in the district were commenced, but later dismissed. He charged that this policy destroyed the possibility of developing possible copper deposit reserves. The basis of the patent annulment suits was that the land was more valuable for grazing and agriculture than for mining. He charged that the purpose of the department was to lease mineral lands instead of granting patents. He said the attitude of the department was operating to decrease copper production. Unless domestic reserves of copper are increased a tariff on imported copper would be necessary or syndicate prices would be paid for foreign copper.



posed grazing titles to valuable western mineral lands.

Known and admittedly valuable mineral districts should be specially treated. Mineral reserves subject to location should be created in areas 10 miles from the nearest producing mine.

Mineral Development

Mr. Smith complained that during the past fifty-three years Congress has done nothing to aid the western prospector or to simplify development of western mineral resources. He paid a glowing tribute to the prospector and urged that he be unmolested in searching for ore bodies. He said the mining act of 1872 was passed primarily to protect gold and silver producers. He asked that the act be amplified to care for production of copper from nonfissure vein areas in Arizona, Utah, California, Colorado, Nevada, and New Mexico. He favored designation of specific areas which would be subject to location under the mining law, and passage of S. 4315, introduced last session by Senator Cameron, authorizing patenting of concentrated ore deposit lands and to allow claims of larger acreage. He opposed grazing titles to valuable western mineral lands.

Known and admittedly valuable mineral districts should be specially treated. Mineral reserves subject to location should be created in areas 10 miles from the nearest producing mine.

The mining committee of the Bisbee Chamber of Commerce recommended legislation to permit patenting of mining claims in the Warren district at $5 per acre. Reference was made to 600 claims on which the department had declined to allow mining patent.

Walter Roche, of Bisbee, also complained against the action of the Interior Department in refusing to issue patents to mining claims in the Warren district, which he said was contrary to the judgment of geologists and miners. He said the patents had been refused on the ground that discovery had not been established, notwithstanding the claims were in short distance of paying bodies.

Stock Homesteads Conflict

The Tucson Chamber of Mines protested against operation of the homestead stock-raising law as it affects mineral lands, and advocated withdrawal from operation of this law of public land designated as mineral land or land which contains mineral. It opposed double ownership of surface and subsurface rights. As the value of the land for mineral purposes is greater than for any other purpose, mineral claimants should have the first call on land containing mineral. More liberal rules and regulations by the Interior Department toward applicants for mineral lands were advocated. It asked that patents be allowed to mineral lands where a showing of ore has been made, together with a reasonable amount of surround-

ing ground, even though valuable mineral be not shown on every individual claim.

Recommendation was also made that Congress pass a new mining law, as conditions have materially changed since the present law was enacted fifty years ago. The new law should promote safety in mining titles and encourage development of the industry. The new law should classify mining claims according to type of ore deposit. The apex law should be limited to true vein deposits. Contact, blanket or disseminated deposits should be located according to legal subdivision with vertical lines. Mining claimants should have the option of performing annual assessment work or paying a tax of $25 per claim. A single showing of mineral in commercial quantities should be sufficient to secure patent for a reasonable amount of adjoining mineral ground. The law should encourage prospectors and miners to develop and secure patent to mineral ground. Authority for each claimant to patent at least ten claims should be given and claimants should be allowed to develop the property as price conditions of the metals warrant.

Interior Policy

Senator Cameron said the attitude of the Interior Department in refusing to issue mining patents had driven nearly every prospector out of the mining States of the United States into Mexico, Australia, and South America, with the result that the American mining industry "is practically at a standstill."

Senator Cameron said the Interior Department, by present rules under the mining laws, almost compels proof of a paying mine before patent will be issued to the claim. This action has deterred mining to a considerable extent. He said the days of wild-catting and claim-jumping had passed. The present law must be modified to meet the situation created by the department rulings.

T. N. Stevens, United States mineral surveyor of Tucson, said the department is getting tighter every year in issuing mineral patents, requiring a showing of actual mineral in commercial quantities. He knew of cases where mineral patent had been refused because of lack of valid location, and subsequently a homestead entry on the same land would be contested on the ground of its mineral character. The policy of the Government agents seemed to be adverse to the mineral applicant. Senator Cameron recited a case where eighteen of twenty-three claimants were rejected to land in the Gleason district of Cochise County, from which ore had been shipped to the El Paso smelter. To develop a mine a group of claims is necessary, said Mr. Stevens.

A. J. Harshberger, of Tucson, recommended that patent be granted to mining claims which have a valuable deposit of mineral, though not in place.

Mine Law Change

"Unless we get a modification of the present mining law or pass a new law that will fit the conditions of the mining business, the mining industry in Arizona, New Mexico, and Nevada will be at a standstill," said Senator Cameron. He said he will reintroduce next session his bill of the last session, with amendments, covering concentrated deposits, or submit a new bill on the subject.

J. W. Stinson, of Tucson, recommended that the oil-leasing law be amended so as to give the prospector double the amount of land now available under a permit and all the proceeds from a wildcat field.

Governor Hunt recommended that lands containing precious metals be ceded by the Government to the States for development.

D. C. Babbitt, deputy land commissioner of Arizona, asked that the State be given 50,000 acres of land for the benefit of the hospital for disabled miners. He said the mineral character of land in Arizona had not been determined when title to it was received by the State from the Government. There have been instances where patents to land have been set aside on the ground that it was mineral when received by the State. He said there had been real mining claims and mining activity on land patented by the State, which it had to reconvey to the Government. In the interest of clear titles a reasonable time limit in which the mineral content of land could be raised should be established.

Senator Ashurst criticized the manner in which the department conducted mineral contest cases, saying they were "secret, and under cover," in that the miner was not informed as to the protestant against his claim. Senator Cameron also criticized the method of the department in acting on cases, saying it did not refer to the inspector's report, but acted on the evidence as gathered during the hearing.

U. I. Johnson, of the Cataract Canyon Power Company, of Prescott, referred to the withdrawal by the Government of water power locations, from which the company had proposed to develop power for mining interests, including the United Verde and the Gold Roads Companies.

A. B. Peach and others, of Prescott, recommended amendment of the mining laws. They contended that mineral locators own the surface of their claims and that stock-raising homestead claims should not be allowed on mineral locations.

HISTORY OF DEVELOPMENT OF ARIZONA'S GREAT MINES

(*Continued from page* 522)

trical prospecting. Most of it being by the Lundberg method brought to this country from Sweden. Electrical prospecting maps have been made in the Superior district, the Jerome district and other sections.

There has been much oil excitement for several years past, but without results in so far as the striking of oil is concerned. Drilling operations have taken place in the Senson field, Elgin field, Duncan field, Bowie field, Beardsley field, Scottsdale field, Yuma field and several other places. The greatest amount of activity, however, has been in the Holbrook field, where a depth of 3,600 feet has been passed. The active wells of this section have been the Taylor-Fuller, Adamana and Navajo-Jerome.

The most important recent railroad development has been the merger of the Southern Pacific, El Paso and Southwestern and Arizona Eastern lines, thus serving the entire southern portion of Arizona with one railroad system. Construction is about completed on a new section of the Southern Pacific, starting east of Casa Grande and connecting with Chandler, through Phoenix and Buckeye on present roads, and going to a point in the West to the east of Yuma.

There has been no other railroad construction of importance during the past year in Arizona, although it is of importance to Arizona to note the $10,000,000 construction program of the Southern Pacific of Mexico in the connecting of the southern end of the line with Mexico City, thus opening for railway transportation the West Coast of Mexico.

During the past year the Crown King branch of the Santa Fe railroad has been abandoned and the Jerome Junction, Jerome narrow-gauge railroad, torn up, as Jerome is now served by a standard-gauge railroad through Clarkdale. The narrow-gauge road from Guthrie to Morenci has also been abandoned, as Morenci is now served through Clifton.

All in all, there has been considerable progress in the mining industry of Arizona during the past several years, and so much of it is in anticipation of improved conditions in the near future that it is felt that the people of the mining industry are foreseeing and preparing for much better conditions than they have been experiencing.

The end of the war, with its enormous surplus of copper, was a severe blow to the copper-mining industry, and it has withstood the shock remarkably well. The recovery from the shock is practically complete, and Arizona is in shape today to produce more copper than even during the peak of wartime production and with every indication that it will make a new peak before long.

PRODUCTION AND USE OF ROCK DUST

A Discussion Dealing With The Chemical And Physical Properties Of Rock Dust, Sources Of Supply, Equipment Required, And Its Production And Use—Rock Dusting Now Recognized As A Real Factor In Mine Safety

By ROY REDDIE*

THE ghastly tragedy of Courrières convinced mining men everywhere that the genesis of many coal mine explosions was imperfectly understood. Suspicion of a weak link in our chain of knowledge regarding them became widespread. Just previously some laboratory experiments had convinced even eminent French physicists that coal dust suspended in an atmosphere free from hydrocarbon gas accumulations would not explode. Then, as if to convince man of the folly of accepting laboratory experiments as an end rather than as a beginning of investigation, there occurred that frightful calamity at Courrières, France, in 1906, which snuffed out the lives of eleven hundred men. Galvanized into concrete thought and vigorous action by the magnitude of the catastrophe the coal operators of France and England financed investigations with a view to discovering the cause and prevention of coal mine explosions in general. In the following year, 1907, a Federal appropriation was made here in the United States which had for its chief object the investigation of such explosions, and the Bureau of Mines was established. At the experimental stations of France, England, and America it was quickly discovered that coal dust was explosive when suspended in air, even when free from gas accumulations. The cause of what had been considered mysterious explosions was not alone discovered, but a remedial measure was found.

Now, the explosibility of coal dust suspended in air and exposed to a source of ignition, and the retarding effect of rock dust upon an explosion so originating are accepted facts of mining science. That rock dust would hinder the spread of a coal mine explosion had been previously noted by several keen observers, notably by William E. Garforth in England and by George S. Rice in the United States.

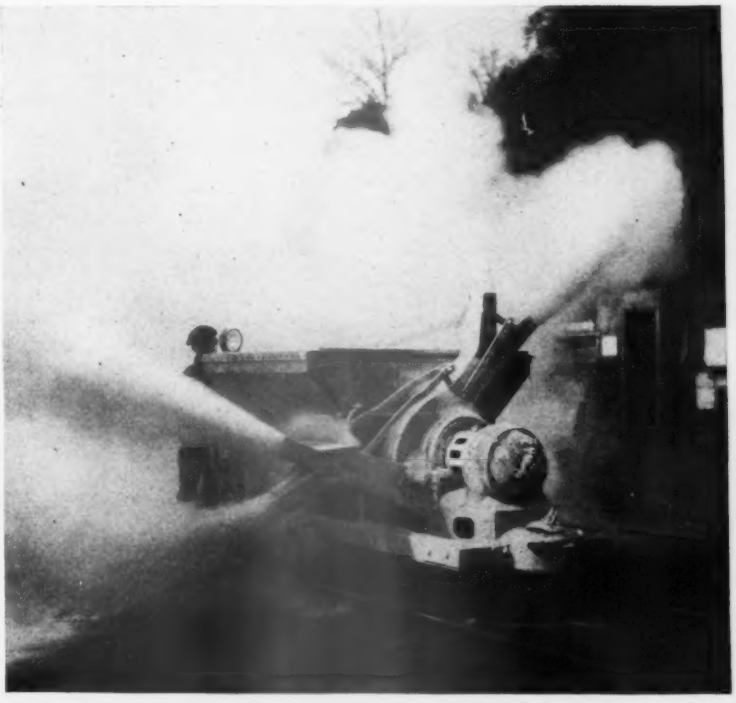
The main trend of thought, however, favored "watering of the coal dust" until several explosions occurring in mines so treated aroused grave doubts of its value and the supporters of rock dusting multiplied.

The appalling mortality of the World War diverted men's thoughts from the grave dangers of coal mining and, in the effort to get the coal so urgently needed, the miner continued to take a chance. With the cessation of hostilities, however, the demand for safer mining conditions again became insistent. The Departments of Mines of France and England and the United States Bureau of Mines urged rock dusting. The British Regulations of 1920 enforced its use in dry bituminous mines and later, as the result of several explosions in wet bituminous mines, the enforcement became general. Human life must be safeguarded from coal dust explosions.

The one certain safe place for coal dust is outside. But all of it cannot be loaded out. In a working mine there is a steady accumulation of coal dust on the roof, ribs, and floor of all excavations. A very small amount of such dust will prove extremely dangerous. Tests by the Bureau of Mines show that one pound of pure fine coal dust ground to 200 mesh and distributed in 200 cubic feet of air is enough to propagate a coal-dust explosion. Even if 25 percent of water is present in a fine pure coal dust it may not prevent an explosion which, once started, will travel through wet places, even where water is standing in the roadway.

Watering having failed to avert disaster and no major explosion having occurred in a properly rock-dusted mine it seems that rock dusting is the safest remedy against explosion so far discovered. So it may be profitable to investigate this safety material, rock dust, as recommended by the British and the Bureau of Mines in this country. Just what is it?

Accepted specifications state that it is rock ground to a fineness of 100 percent through 28 mesh and 50 percent through 200 mesh. For obvious reasons it must be free from combustible matter and for humane reasons it must be practically free from crystalline silica. Preferably it should be light colored and it must be inexpensive.



U. S. Bureau of Mines photo

Fig. 1. Miller-Harmer Rock Dusting Machine

SIZE OF PARTICLES

It is the consensus of opinion that the fine particles are the most effective. The Bureau of Mines used in most of its tests a 90 to 95 percent minus 200 mesh dust. Using a coarser material it was found that a greater quantity of dust was needed for safety. The writer's belief is that the minus 150-mesh material is alone of much value for "dusting." If applied by mechanical dusters coarse dust must be projected from the machine at an uneconomically high velocity. Some coarse material is probably advantageous when the dust is applied by hand or thrown from a scoop. Thus applied such dust would probably better penetrate deposits of

*Consulting Engineer, Knoxville, Tenn.

coal dust and a better mixture would result.

In general in America, however, a mechanical duster will be used which will cause the coal dust to rise in a cloud where it will meet the rock dust in the air and become intimately mixed with it and the mixture will then settle on the enclosing sides of the excavation still in intimate association. This will occur if the rock dust is ground fine enough but *not* if it is ground to a dust splitting on 28 mesh.

Mineral particles free to fall in air conform to the operation of certain natural laws. When a mixture of mineral particles is thrown into a medium, such as air, and are not too crowded, they will fall in obedience to "the law of equal settling particles under free settling conditions." In obedience to this law "mineral particles under free settling conditions fall directly as to their mass and inversely as their superficial area." This just applies, practically, to mineral particles of appreciable mass.

When mineral particles are ground to an impalpable powder, however, and projected into a medium, such as air, they tend to remain in suspension and, consequently, in close association for some time, even if of high specific gravity. Because of this fact, very finely ground minerals (ground to impalpable powder), even if of widely different specific gravities, are not amenable to mechanical methods of separation and concentration.

Therefore, mixtures of very finely ground coal and rock, intimately mixed, and projected into a medium, such as air, will remain in intimate association for some appreciable length of time and will tend to settle, still in intimate association, upon the enclosing sides of the chamber containing them. And if later disturbed by a concussion they will repeat the cycle and the percentage of coal dust-rock dust mixture on any given side of the chamber will be approximately maintained. If particles of appreciable mass are introduced, however, they will fall rather rapidly.

If two minerals of specific gravities differing by as much as one point on the scale be thrown into a medium such as air they will separate in accordance with the law just stated. Concentration of the denser particles downward will be rapid unless the superficial area of the denser particle is so great that separation is prevented, in which case both mineral particles will fall at the same speed. This will not be the case with coal dust-rock dust mixtures. For a given volume of particles, the coal dust will, in general, have an equal or greater superficial area than the rock dust particles. This will be noticeably the case in the extremely dangerous dust produced from coal which has been largely formed from "spore" accumulations. Therefore, in general, the separation of the rock dust-coal dust mixture will not be *retarded* and there will be a concentration of the rock dust particles toward the floor of the excavation.

The specific gravity of the rock available for the production of cheap dust will vary from 2.2 to 2.9 and the specific gravity of bituminous coals will vary from 1.2 to 1.4, so that there will be a difference of one point on the specific gravity scale between them. With this difference in the specific gravity of particles, under free settling conditions there will be a rapid separation of the denser particles downward.

But most of the coal dust adhering to the timber, roof and ribs is very fine, and often, extremely flocculent. From such coal dust all the rock dust of plus 100 mesh will separate rapidly when thrown into suspension, and the concentration downward of the coarse particles of high specific gravity will leave a rich mixture of flocculent coal dust in suspension near the roof mixed with whatever fine rock dust was present in the original mixture—but, there may not be enough rock dust left in the mixture to prevent propogation of an explosion.

Let us assume a condition that may readily occur near a working face: A long room has been "dusted" with standard specification dust to within a practicable distance of the working face. Possibly the coal is very dusty. A gripped shot, overloaded, causes such a concussion that the coal dust-rock dust mixture is thrown into suspension. A condition similar to that assumed in the last paragraph results. If a "blown-out shot" now occurs a long hot flame will be projected into a zone rich in volatile coal dust and the probabilities are that an explosion will result which may reach the first barrier. Of course, if stopped there, or thereabouts, congratulations will be in order because a disaster was averted. But the explosion might have been arrested within a few feet of its origin if sufficient fine dust had been used in "dusting"—dust fine enough to remain in suspension until all danger from a blown-out shot was past; or if a method to be discussed later had been adopted, i. e., *to dust the flame of the blown-out shot.*

There is nothing improbable about this hypothetical case. The miner who carelessly places a shot to grip the rib will probably be equally careless in estimating the amount of explosive required and in neglecting to properly tamp the hole. Such a man is a menace to a mine. Also, the management that stands for that kind of shooting is liable to be equally careless in general inspection and so the grinding plant will get by with the production of much coarse dust just to maintain the tonnage of dust—and that is money thrown away, with the possibility of a heavy property and life loss to follow. Upon the evidence extant there is no reasonable ground for the assumption that coarse rock dust is of any value for dusting even when fairly large amounts are used *unless a considerable amount of fine dust is present in the mixture.*

In crushing and grinding rock, even to comparatively coarse screen sizes, some fines are unavoidably made, and so, a large amount of unscreened coarsely ground rock may carry enough fines to retard an explosion when present in sufficient quantity to yield the requisite amount of incombustible material *after the coarse particles have settled out.*

But it can be readily seen that a grab sample taken from the floor, roof and rib of a rock-dusted mine is one thing, and a sample of the suspended coal dust-rock dust mixture taken close to the roof after the law of equal settling particles has been operating for some seconds, may be something else. And that is where the danger zone lies! It is in such a mixture, in such a place, that explosions are liable to originate and by propogating in the richer mixture of fine coal dust next the roof (left by the settling out of the coarser rock dust) develop to violent proportions and leave behind a train of damage and danger—the one an element of expense to the mine and the other an element of danger to the miners who may have to clean up and retimber that room.

To base a hope of averting coal dust explosions on applications of rock dust running high in coarse particles is as wise as building a house on shifting sands. In either case danger of disaster ever approaches! A good mixture of coal dust and coarse rock dust may be made by expending enough power on the application of the rock dust. But with every subsequent disturbance of the mixture there will be a concentration downward of the heavier rock dust particles until a dangerous condition may result. The danger point may approach more rapidly in one mine than in another, depending upon the frequency and extent of the disturbances which permit "the law of equal settling particles under free settling conditions" to operate, but that with every disturbance the point of danger will approach is certain. For these reasons it is writer's opinion that rock dust for "dusting between the working faces and the second line of defense," viz, the first barrier, should be ground to 100 percent minus 150 mesh and 90 percent minus 200 mesh.

For charging barriers, however, a dust containing coarser material may

be better suited to the end in view. Consider the case of a flame projected toward a barrier. It is conceivable that a charge of dust ground extremely fine might be repelled from an exploding gas where a coarser material would rupture and penetrate the outer envelope of the flame and carry into its vortex a mass of dust to chill and smother the flame.

Siliceous Content of Dust

Medical authorities who have studied the subject closely concede that coal dust exerts a neutralizing physiological effect on inhaled rock dust. Nevertheless, as silica in a crystalline form breaks in sharp grains and splinters, it is known to be distinctly harmful when inhaled. Therefore, dust containing any appreciable amount of silica in this form is condemned. But all rock dusts reported by the chemist to run high in silica are not necessarily harmful. Shales, slates and clays run high in siliceous content, although but few of them run high in the form of silica condemned. Principally, the siliceous content exists in the form of aluminum-silicates. This is not known to be particularly injurious, otherwise all of us would make a quick hop toward the grave every time a flivver passed us on a dry clay road. Do not condemn a cheap likely looking source of supply on an ordinary chemical analysis. Get a petrographer's opinion.

Chemical Composition of Rock Dust

From tests made at Eskmeals, England, "The Explosions in Mines Committee" ventures the opinion that the fineness of an incombustible dust *rather than its chemical composition* affords a measure of its probable effectiveness in preventing the ignition of coal dust with which it may be mixed. And yet that committee advises:

"1. The maintenance throughout the roads of such a proportion of incombustible dust in a state of fine division as would make a mixture yielding on incineration at least 50 percent ash, or

"2. The maintenance of at least 30 percent water in a state of intimate mixture with the dust throughout the roads, or

U. S. Bureau of Mines photo

Fig. 2. Rock Dusting Machine, Pittsburgh Terminal Coal Company, Coverdale, Pa.

"3. A combination of the two previous methods."

The value of the water, of course, is that it takes up so much heat in a latent form during the conversion of the water into steam that the flame of a gas explosion causing such vaporization may be cooled below the ignition point and die out. In the vaporization of water at, say, 80 degrees F. into steam from direct contact with a gas flame, approximately 1072 B. T. U.'s would disappear from the flame for every pound of water so vaporized. So if enough moisture be present the flame will cool off and die out.

If, on the other hand, the rock dust consist of calcium carbonate ($CaCO_3$) ground to pass 150 mesh, it would be easily dissociated by heat. Exposed to a temperature of 1,650 degrees F. the dissociation of calcium carbonate to lime (CaO) and carbon dioxide gas (CO_2) would be rapid and for each pound of calcium carbonate so dissociated 772 B. T. U.'s would disappear. Therefore, this material is 72 percent as efficient as water for cooling a very hot flame, such as the flame of a gas explosion. And after complete disassociation it still leaves (for each one hundred pounds of calcium carbonate so dissociated) 56 pounds lime dust and 44 pounds carbon dioxide gas (the black damp of the mines) present in the air to resist further combustion.

The objection that it rapidly absorbs moisture in humid mines has been offered to the use of limestone dust. This is probably due to the use of dust containing too much coarse material, as limestone, when ground to very fine powder, becomes, to a notable degree, non-absorbent of moisture.

Source of Rock Dust

The user will have to be guided by common sense in selecting a source of rock dust. Let him look around and see if nature has not supplied a cheap source of supply adjacent to the mine. Nature has been in the rock grinding business for ages, producing rock dust by various agencies. The material immediately available may not be an ideal one, physically or chemically, but for the maximum effectiveness of each dollar's worth it may be a winner.

For instance, that "far-flung" earthy deposit known as "loess," which is akin to and in many cases identical with the adobe soils of the arid regions of the West, might have been produced by nature for this very purpose! An eolian formation, light colored, finely ground porous particles, is cheaply obtainable and can be readily brought to a state of fine dust by simple, even primitive grinding methods. It quite often runs high in calcium carbonate.

Glacial clays might be utilized in some places. These have been ground to powder under conditions protecting them from decomposition. For "home grinding" the shale or slate at the mine may be the best source of supply for the production of dust with small grinding outfits. These will probably yield the cheapest source of supply if the freight haul on dust to the mine is a long one.

Impure calcite, soft limestone, gypsum and anhydrite may all be used. The harder limestones and dolomites make good dust, but it is not wise to attempt their reduction with small grinding plants. To attain maximum efficiency for this purpose limestone should be ground to pass 200 mesh and this can alone be economically accomplished with large reduction plants.

A rock for reduction to rock dust for this purpose should be free from silica and combustible matter, cheaply obtainable, easily reduced, light colored, non-absorbent of moisture when finely ground, run comparatively high in carbonates, easily dissociated by the heat of a hot gas flame, and be free from

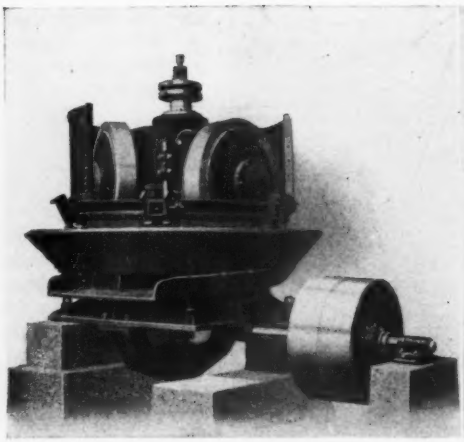


Fig. 3. Evans-Waddell Chilean Mill with part of housing removed

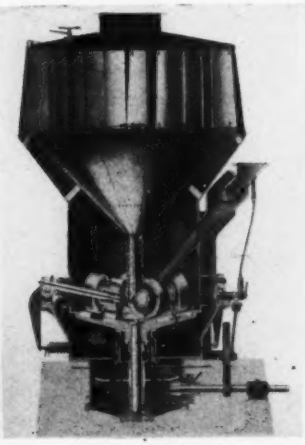


Fig. 4. Bethlehem Pulverizer, housing removed. Made by Bethlehem Steel Co.

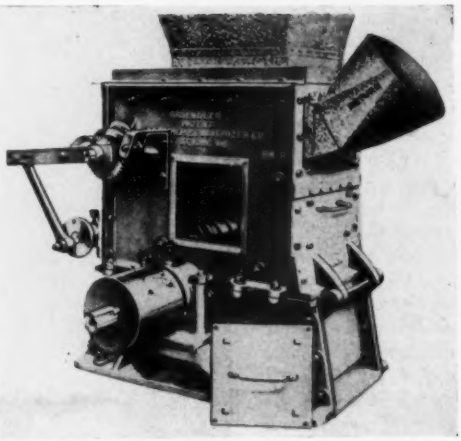


Fig. 5. Gruendler Impact Beater Mill

colloidal matter, otherwise the dust will rapidly absorb moisture and become a sticky mud.

Chalk when properly ground makes an ideal material and plastic clays because of the readiness with which they absorb moisture stand at the foot of the list. But between these two extremes there is a wide assortment of material to select from.

Rock-grinding Machines

In an article of this nature it is not necessary, nor even desirable, to attempt to cover the field of fine rock crushing. The following short description of the different types of fine rock crushers may, however, assist the busy coal mine executive when in the market for a small plant. Briefly, it may suffice to state that the machines offered by American manufacturers for dry grinding are of the following described main types, viz:

1. Radial Roller Mills.
2. Centrifugal Roller Mills.
3. Ball Mills.
4. Hammer Mills.
5. Pestle and Mortar Mills.

The best known representative of the first class is the old Chilean Mill. This is probably the oldest fine grinding mill, for the reduction of rock, in existence, having been developed from the old Mexican Arrastra. It used to be said by concentrator millmen that "a chilean mill is a good thing to be able to do without" because of its tendency to produce an excessive amount of "fines," material so fine that it could not be concentrated.

It is obvious that when broad-faced rollers, as illustrated in Fig. 3, travel on a circular ring of comparatively small diameter, that the outside edges of the rollers must travel farther than the inside edges. Consequently, the center line of the roller face is the only part of the roll exercising a true crushing action. On each side of this center line continuous "slip" occurs, with the result that a triturating, or true grinding action continuously occurs. This caused the chilean mill to be a notoriously bad "slimer" and because of this it was superceded by other types of fine grinders and became almost obsolete. Fig. 4 will show, however, that this type has again returned to the crushing field in a highly specialized form, especially designed for dry grinding. This Bethlehem Pulverizer is fitted with an air separator which runs in closed circuit with the mill. Thus, by setting the air separator to pass material of the desired fineness the coarser material continuously falls back into the grinding zone until reduced to the desired fineness. This is a new addition to the rock-grinding field—but there is nothing new about the type. And the sliming tendency of this type mill which made them so objectionable that they were discarded from the concentrators may lead to their favorable reception in a field where the object is to make the maximum amount of "fines," viz, the production of rock-dust and for pulverizing coal. These radial roller mills of the chilean mill type were about as foolproof as anything that was ever built to crush rock and the maintenance cost and power input was low.

Centrifugal Roller Mills: The Huntington Mill, used for years for the fine grinding and amalgamation of gold ores, was the first mill of this type—the modern representative, adapted for dry-grinding, is the Raymond Mill. In these mills the rolls are carried on arms suspended from a yoke which revolves at a high speed, causing the rolls to swing outward against a die ring. The crushing is accomplished by feeding the rock between the rolls and the die-ring. These mills must be carefully fed for best results. This mill is widely used for pulverizing coal and some of the softer minerals.

In regard to capacity and power consumption of these mills the Raymond Mill builders had this to say of their "Ray-Monarch" Mills: "Quite a number of changes in design have been incorporated as the result of our own experience with the present machines and these changes have materially improved the mill, *giving larger capacity for the amount of power employed.** * * It shows a capacity on the average grade *of bituminous coal* of better than 15 tons of coal per hour to a fineness of 90 percent or better through 100 mesh, with an expenditure of 225 to 250 horsepower for mill and fan."

From the above I assume that one of the smaller less efficient types would demand a heavy power input to produce a rock-dust, 90 percent of which would pass 200 mesh. This company is working on a unit for the production of rock-dust in small amounts but their tests have not yet reached finality.

A mill somewhat analogous in action to the centrifugal roller type is the "Open-Door" Ring Roll Mill, built by the Sturtevant Mill Co. In this mill the rolls are held at fixed points and the die-ring is caused to revolve, the material being crushed between rolls and ring. An air separator is used in circuit with the mill for fine grinding. A likeable feature of this mill is its complete and ready accessibility. It must be carefully fed for efficient results. This applies to all the centrifugal roller mills. A more intelligent grade of help is required to operate them than is the case with any other crushing device known to the writer.

Ball Mills: There are two types of ball mills, viz, those in which the balls travel in a fixed path and those in which a large mass of balls tumble over promiscuously within the mill as it revolves.

In the first class the ball travels on a fixed path or "race" that may be either vertical or horizontal. The race and balls are subjected to uneven wear, consequently the work becomes unevenly distributed and the balls must be "scrapped" after they are worn to some extent. The Fuller-Lehigh Mill is of this type and enjoys a reputation for fine crushing of certain materials.

Fig. 6. Sectional View of Allis-Chalmers Dry Grinding "Compeb" Mill

By far the greatest tonnage of rock reduced to fine mesh sizes made in the world today is produced by ball mills of the second class, known as tube-mills. As the name implies, these mills are simply tubes of large diameter lined with a wear-resisting lining and loaded with a large charge of balls, which may be either pebbles or steel balls. As the tube mill revolves these balls "cascade" over continuously and thus pound the rock into dust in dry grinding or into pulp in wet grinding. The balls are, in time, completely worn out by this tumbling action and new balls are fed to the mill in small amounts at regular intervals.

The rod mill is a development of this type. In this mill the crushing is accomplished by using a charge of long steel rods which also cascade over as the mill revolves. Regular commercial sizes of round steel rods are used. Simple types of liner can be used in this mill. The rods come cheaper than balls and the mill is exceptionally easy to keep in repair. There is a 3' x 6' Marcy Rod Mill built which has a fair grinding capacity, and, if, run in closed circuit with an air separator, should make a good rock-dust grinder with capacity sufficient for any one operation.

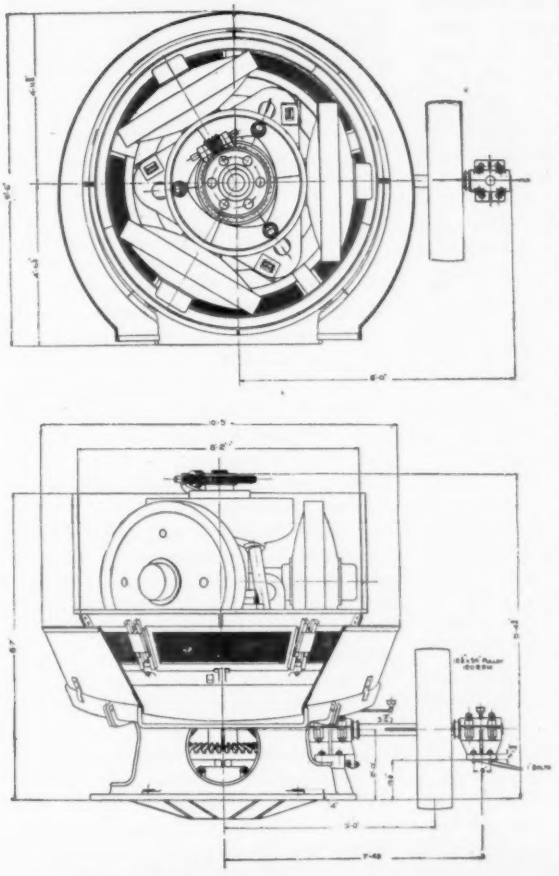


Fig. 7. Chilean Mill of the Allis-Chalmers Manufacturing Co.

For a large operation, such as a mill built to provide dust for a number of mines, one of the larger and more modern tube-mills should be installed. Fig. 6 illustrates the "Compeb" Mill built by Allis-Chalmers Co., Milwaukee. This mill is a favorite in the cement industry, where it is used to reduce kiln-run clinker to finished cement in one operation.

The Hardinge Conical Ball Mill is another development of the tube mill. It is asserted that the balls segregate in the mill, and the larger balls occupying the largest diameter of the mill and the smaller, or worn balls, working up toward the discharge end of the mill, and that because of this grinding capacity is increased. When wet grinding to certain meshes there may be something to this assertion, but when dry grinding to very fine meshes the well-known cushioning effect of dry ground dust, where it is "crowded" toward the discharge of the mill, must practically prevent much grinding action from taking place in that zone. If, however, the fines are swept out of the mill on an air current as they are formed, then I am prepared to admit that an appreciable amount of crushing may take place in the conical part of the mill near the discharge aperture.

So we find this company offering small units for the production of rock-dust, fitted with very complete air separators. A stationary mill and a portable mill are

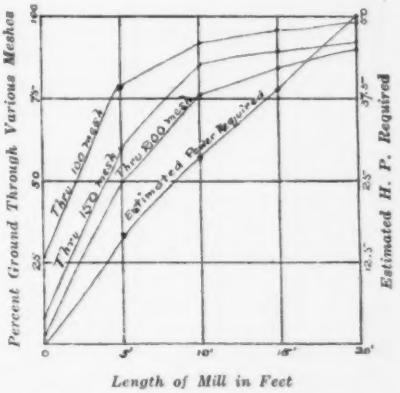


Diagram showing percentage of material ground through different meshes in 4' 6" diameter x 20' length tube mill (arranged for test to discharge at 5' intervals as required).

offered. Fig. 8 shows the latter with a worker distributing rock-dust straight from the grinding machine.

The stationary outfit is said to produce one to two tons per hour of dust, 60 percent of which will pass 200 mesh when working on medium hard limestone and taking feed crushed to ¼". This means a primary crusher must be used, in which case I would use a hammer mill and crush to ⅛" mesh before passing feed to the tube mill. This company is making a special effort to meet the demand for small plants for coal mine use.

TABLE 1.—Dry Tons Ground Per Horsepower

No. Test	Time Hrs.	Test Data Tons	Length	Estimated Power H. P.
1	48	120	5′	17
2	72	180	10′	28
3	60	150	15′	39
4	48	120	20′	55*
5	48	120	20′	50*

*Actual readings.

The chart and table given above shows the capacity and power input on a tube mill test. A study of this chart will show the necessity of careful slow grinding. It also shows the "jump" in power input consumed when grinding to very fine meshes.

Hammer Mills: "The Hinged Hammer Principle" consists of a suitable mill housing within which a properly designed rotor revolves. The rotor consists of a strong shaft upon which discs or hubs are mounted and from these discs or hubs loosely hung hammers are suspended by through bolts. When the rotor attains high speed the hammers stand away from the shaft, due to centrifugal force, and if the speed is right they strike the material to be crushed like a rigid rod and "follow through" the blow so that the material shot forward by the force of the impact is smashed against the breaker plates. The hammers strike thousands of blows a minute and are so mounted that when the rotor is rotated rapidly it runs in balance—this being important. It is also most important that the speed be such that the hammer will not yield to the force of the impact and thus be swung backward. If so, the rock will "slip" on the face of the hammer and the wear of steel will be excessive.

When the material is crushed fine enough (within the limitations of the machine to accomplish this) it escapes through screens provided for this purpose, or is otherwise taken care of by an air current, for instance.

The size of the product in hammer-mill reduction is largely a matter of design of hammers and grates. To show the wide range of sizes that may be made by these mills two instances may be cited: The San Antonio Portland Cement Co. reduces limestone from 36" to 1½" and finer in one operation *and 75 percent of the product is reduced to powder.* In Ohio, there is a lime-burning plant using a hammer mill which takes 12" feed and only 5 percent of the resulting product is minus ¼".

Some radical claims are made in behalf of the hammer mills which should be discounted. The mechanical advantages, of course, are readily apparent; there is no lost motion of reciprocating parts and the power applied to the machine is stepped up by centrifugal force to a point where the effect is most intense. The nonfluctuating high speed and "follow-through" effect is maintained by a heavy fly-wheel effect. And it has other advantages also. But when the assertion is made that "it is free from damage by tramp-iron because the loosely suspended hammers permit them to swing back out of the way until the metal passes through," my mind drifts back to that biblical statement about a certain unfailing characteristic of men.

Of late, certain types of hammer mills have been more especially designed for pulverizing than for crushing, the Gruendler Impact Beater Mill, illustrated by Fig. 5, for instance. This shows a rotor upon which loose rolls are suspended instead of hammers. The material enters the mill and comes into the path of the flying rolls which at this point act as hammers. Reduction begins by impact—the impact of the rotor and the impact of the material projected from the rotor against the breaker plate. And, of course, there is a steady bombardment of the partly crushed material by heavier pieces projected from the rotor, which still further effects reduction. Then this partly crushed material is driven forward by the flying rolls on the rotor and still further reduced by them against a corrugated grinding plate in the bottom half of the mill.

In circuit with this mill there is an air separator which removes the material fine enough for the purpose in view and returns the "rejects" to the mill for further reduction. The air separation system is controlled by a variable speed transmission which permits great flexibility in the operation of the entire outfit. The air system alone is so flexible that material of 50 percent minus 200 mesh may be changed to a product of 90 percent minus 200 mesh by the variable speed transmission alone.

Pestle and Mortar Mills: When the chemist in the laboratory wishes to grind a material to a very fine state of attrition he uses a pestle and mortar. This principle has also been adopted in the design of a machine for the fine grinding of rock. The Griffin Mill is of this type. In Great Britain, I am informed, more mills of this type have been installed to grind rock-dust than all other mills combined. It is somewhat difficult to obtain data from the company manufacturing these mills but from an outside source I am informed that a 30-inch Griffin Mill working on shale broken to ⅝" round ring pulverized 2,500 pounds per hour to 80 percent minus 200 mesh with a consumption of 25 horsepower. This is rather good work even if the mill required close attention which, from an early experience of my own in ore reduction, I think likely. This mill would have done better on a finer feed and as the size of the feed (⅝") would demand a primary crusher set very close it would be better practice to put in a small hammer mill to crush this shale to ⅛" and finer and then finish grinding in the Griffin Mill. But this applies to all the fine grinders, except the hammer mills.

It can be seen then, that mills of several radically different designs can be used to make rock-dust. The best mill for an individual coal mine to purchase depends on so many factors that no definite rule can be laid down. From the conflicting statements made in favor of one form or another, of fine grinders, however, one thing is clear, viz, the fines should be removed as quickly as possible, and this should preferably be done by air separation, and the air separation system used should permit of quick change from medium coarse to very fine dust, as required, without any change in the grinding unit.

The Use of Rock Dust

When a mechanical distributor is to be used, all the dust should be ground to 100 percent minus 150 mesh. Such dust is easily distributed, mixes in suspension with the coal dust, enough of it will settle to dust the floor, and the rest will settle with the coal dust upon roof and ribs, and intimately mix with it. If all places are dusted with this dust to within a practicable distance of the working face, few, if any, explosions will ever reach the first barrier, if they originate in the room.

Barrier charges of dust could be minus 20 mesh plus 150 mesh, with a little finer dust mixed in, and it may well be that some 10 mesh material would be an advantage in barrier charges of dust because of its greater rupturing value on the flame of an explosion. Such coarse dust is very cheap, and large charges of it can be used in the barriers at little cost. This dust, ground from a suitable shale would not take up much moisture in a humid mine, not enough to convert it into a mud. And as long as the moisture does not cause the particles to cohere into a sticky mass, but allows them freedom to spread in a sheet of loose particles across the flame of an explosion, the damping of the dust will render the dust barrage more efficient

because of the rapid absorption of heat as the moisture is turned into steam.

Systematic dusting of entries, inclines, etc., will void the danger from explosion due to runaway trips, heavy electric arcs from derailment and other causes of explosions at these points. But rock dusting will not immediately meet the emergency of a "blown-out shot" because it is not practicable to carry the dusting along with a retreating working face. There will always be a danger zone left by such a retreating working face and there dust may collect.

The certainty of the rapid development of mechanical loaders and conveyors in American coal mining practice means an increased capital investment. In order to meet this investment by appropriate returns, coal miners will be forced to do that which metal miners have done for generations, viz, double-shift the working faces. So in this danger zone even a slight explosion may cause heavy loss. So we must avoid careless shooting to the best of our ability, but not fool ourselves into thinking that with all our care a blown-out shot will not occur. Fortunately, we are able to make such a shot dust the flame of its own explosion.

Some enthusiasts have contended that "rock-dust stemming" would cause the shots to dust the room. A slight consideration of the physics of the case would have shown the unlikelihood of this. If a shot is properly placed and properly tamped the energy of the explosive when fired is expended "heaving its burden" and the tamping will be undisturbed until the coal is thrown into the room, when it will land on the floor with the coal. The value of tamping, of course, is to confine the gases generated by the explosion of the charge within the chamber until they have expended their energy in overcoming the resistance of the coal to breaking from the seam. A high temperature results from the explosion of the charge in a confined chamber. If the tamping resists dislodgement the coal yields along the line of least resistance. This yielding of the coal rapidly enlarges the chamber enclosing the gases, which expand rapidly, accompanied by a rapidly lowering temperature. If the charge has been nicely calculated most of the heat of the explosion will be converted into useful work, the work of breaking the coal and rolling it out into the room. Consequently, at the time of the release of the gases, they will have been so cooled by expansion that their temperature will be lower than the temperature of ignition of gas and coal-dust.

U. S. Bureau of Mines photo

Fig. 8. Hardinge Combined Pulverizer and Rock Dust Distributor

Sometimes, however, shots blow the tamping. These blown-out shots are dreaded by careful miners, because, from the collar of the hole, following the yielding tamping, a long hot flame is projected into the room often with disastrous results.

Now, if we assume that a cloud of mixed coal-dust and rock-dust in the proportion of 50: 50, stirred up in front of the advancing flame from ignited coal-dust in a working, will smother that flame, may we not reasonably assume that a cloud of 100 percent rock-dust interposed as a screen in front of a flame from a blown-out shot will prove equally potent? This seems a reasonable assumption, hence the philosophy of "rock-dust stemming."

The value of rock-dust stemming for dusting the room is probably negligible, but for guarding against ignition of coal-dust from a blown-out shot it must be of considerable value, otherwise the whole philosophy of rock-dusting breaks down. Unless introduced into the hole in a stiff-walled container, it will be blown out into the air in front of the hole, in the case of a blown-out shot, and the flame will be projected into a cloud of pure rock dust. The tamping containers should be just stout enough for easy handling, but weak enough to break easily, when tamped into the hole.

Let anyone have two holes drilled into a shale or slate outcrop so that they will blow the tamping when loaded and fired. Use rock-dust tamping in one and bug-dust tamping in the other. Shoot them after dark and watch results from a safe place. The rock-dust tamping will not make such a spectacular display as the bug-dust tamping, but ever afterward you will feel safer if you have to stay in the mine around shooting time, or even if you just have your money invested there.

Rock-dusting must be thorough to be effective and safe. Some are just making a bluff at it. In some mines a few barriers have been put up consisting of one swinging board carrying a load of rock-dust, but with no dusting of the entries or rooms. Anything like that is just a mere gesture! Anyone relying on such a a measure is camping under a "dead-fall!"

If rock dusting cannot be done thoroughly it had better not be attempted. Even when done thoroughly it will still be necessary to enforce every safety measure dictated by experience to insure the reasonable safety of the mine and the miner. It is not contended that rock-dusting is an absolute safe measure. It is simply contended that it is the nearest thing to safety of which we are now aware for preventing the propagation of a coal-dust explosion. Consequently, it should receive a fair and impartial trial. It cannot, of course, be tried regardless of expense. The fact that the coal mining industry is struggling on the thin edge of bankruptcy forbids the operating force spending money upon unproven expedients. Rock dusting has now advanced to the stage of "demonstrated value." But, if adopted, it must be used thoroughly.

If the introduction of this proven safety measure leads to relaxed vigilance in other directions, possibly nothing will be gained by its introduction. Too often a safety measure laxly enforced breeds carelessness among employes and leads to a more perilous condition than it supplanted, because a dangerous condition faced by experienced men with appropriate precaution may be much safer than a "near-safety measure." Men should not be fooled into trusting any new measure of safety improperly applied; either make conditions safe or inform them that they must use *every* precaution to meet dangerous conditions.

Do not adopt a measure of safety just because it has become fashionable. Become convinced that a certain thing to do is the right thing to meet the particular conditions of your operation; then do it thoroughly.

In any branch of industry the man who directs the efforts of a human being in the production of the world's needs is, indeed, "his brother's keeper." It has gotten to the point where it will no longer (*Continued on page* 569)

METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Metal Mining Industry

HANDLING OF MATERIALS IN UNDERGROUND MINING

Use Of Mechanical Labor-Saving Equipment In Underground Mining Is Surrounded By Such Obstacles That Certain Work Still Relies Wholly Upon Hand Labor For Accomplishment—This Article Gives A Brief Sketch Of Recent Progress In Practice

By GUY N. BJORGE*

ECONOMISTS and political scientists call this the mechanico-industrial age. They prophesy that it will not be remembered for its great works of art, of music or of literature but for its great bridges, its great dams, its great buildings and its highly developed machines. The scientist, inventor and technician have worked incessantly and untiringly to develop and perfect mechanical devices that might lessen or replace physical labor. Their efforts have been largely directed toward lessening the amount of human toil required to accomplish a given amount of work. And the results achieved have been remarkable.

Mining, along with all other branches of industry, has shared in this progress. The discussion which is included in the Practical Operating Men's Department in this issue, is concerned with that progress in but one branch of mining, namely, underground metal mining. The subject, "Handling of Materials," covers nearly all operations in mining. The following articles on some phases of this subject will be found on the immediately following pages of this issue:

"Transportation and Distribution of Underground Supplies at Miami Copper Company," by A. C. McDermid and J. C. Conniff.

"Material Haulage and Hoisting at Inspiration Consolidated Copper Company," by A. C. Stoddard.

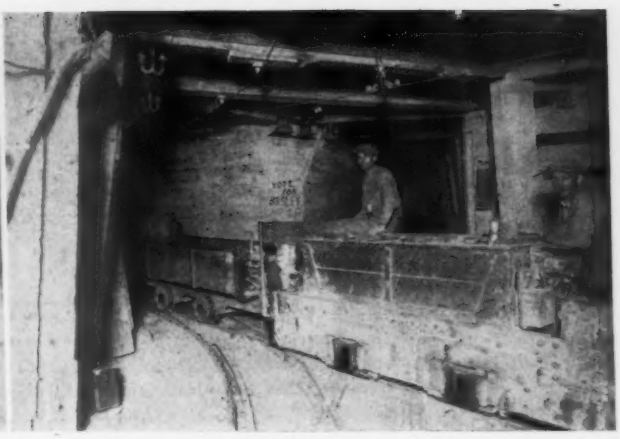
"Transportation and Handling Ore and Waste at Magma Copper Company," by F. W. Snow.

Double Track Concrete Haulage Tunnel, Ray Consolidated Copper Company

It is probable that no other branch of industry offers such great obstacles to the introduction and use of mechanical labor saving equipment as does underground mining. And certain work in the mine still relies almost wholly on hand labor for accomplishment. For example, no machine has yet been developed to effectively take the place of hand shoveling in ordinary sized drifts. But, in spite of the many difficulties, progress in the introduction of labor-saving machinery in mine work has been rapid. Without looking backward to the methods of earlier days the amount of progress is hardly realized. And, in doing this, it is not necessary to look back to the days of very primitive methods—the days when ore was transported from the mine in rawhide bags on the backs of the laborer. Let us consider briefly the progress in the methods in underground transportation and hoisting of ore in the metal mines of the west within the last 20 or 30 years.

Thirty years ago practically all ore mined was trammed by hand in small cars, these hoisted to the surface on cages and again trammed by hand to the ore bins or other place of disposal. And long tramming distances apparently had no (*Continued on page* 570)

*Consulting Engineer.



Left—Otis Automatic Passenger Elevator and Operating Mach inery. Right—570 Level Supply Train. 4-ton Storage Battery Locomotive with steel car filled with sharp steel next to locomotive

TRANSPORTATION AND DISTRIBUTION OF UNDERGROUND SUPPLIES AT MIAMI COPPER COMPANY

The Splendid Results Obtained At This Mine Are Due To (1) Organization Of Supply Department Under One Head (2) Transportation Features Including Track System And Elevators (3) Supply Drift System And Central Tool Room

By A. J. McDERMID and J. C. CONNIFF*

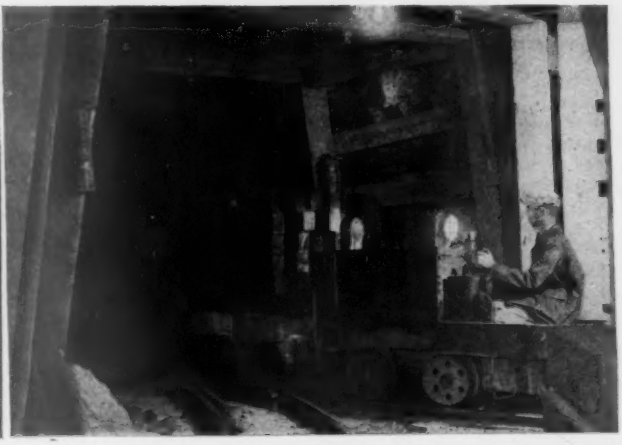
THE mine whose supply system is described in this paper produces 10,000 tons of ore daily with an average underground crew of 355 men.

The first purpose underlying all the efforts of the distribution organization at Miami is to supply everyone in the mine with all the equipment he needs with as little delay as possible. In addition, the attempt has been made to promote efficient methods of transportation and distribution by reducing handling to a minimum, and by preventing loss and waste. While all of the problems that have come up in connection with this work have not been solved, a number of practices have been evolved which are worth noting. As many important details as possible have been included in the accompanying charts and maps, while the text of this paper will be confined to a discussion of the more interesting features of the supply system.

*Engineering Staff, Miami Copper Co.

The general arrangement of the Miami Copper Company's yards, warehouses and shops, from which mine supplies are drawn, is shown in the longitudinal projection (Fig. 1). It is not possible, for a number of reasons, to have all the shops and warehouses located at the main shaft collar; many of these sources of supply must serve the mill and surface departments as well as the mine, and so must be located at places which are most convenient of access for the plant as a whole; the topography of the locality does not allow a railroad approach to the level of the shaft collar, so it is necessary to maintain a supply depot at the railroad terminal in the lower yards.

The section also shows the relative location of the levels in the mine which are now being used. The 720 is the haulage level on which the entire production of ore is transported to No. 5 shaft. Mining work conducted on this



Left—Intersection Main Supply Drift and Stub Storage Drifts, 620 Level. Sprinkler car shown is hauled through main supply and manway once each shift. Right—620 Supply Train, Small Storage Battery Locomotive

level consists of raising and drifting. On the 570 level the principal drift is the main traffic artery of the mine for men and supplies. Most of the levels on which mining operations are being conducted at present do not connect with No. 5 shaft directly, but must be entered by shafts and raises from the 570 level. Above the 570 level are a number of sublevels at intervals of 30 feet. The work on these levels consists of cutting vertical slices along the sides of the ore panels, and is confined chiefly to drifting.

The 620 level, which is also entered from the 570, is at present, and will be for years to come, the base of operations for undercutting and drawing the ore. More men are employed here than in all the remainder of the mine, and 85 percent of the supplies sent into the mine are used on this level and the undercutting level which is 30 feet above it. The unit, in the system of carving employed at Miami, is the stope or panel, which is 150 feet wide and 300 feet long. Three grizzly drifts run the length of each stope on the 620 level and in each drift are 12 grizzlies. Fifteen feet above the grizzlies are the square sets through which all the ore is drawn. These are located at the centers of 25-foot squares. Seventy-two square sets are required for each stope, and each set contains 126 pieces and 20 different sizes of timber. Each stope has its own undercutting level, which is 30 feet above the 620. A plan of the 620 level is shown in Fig. 2, and this will be referred to more in detail later.

Personnel of Distribution Organization

Distribution of underground supplies is supervised by a supply engineer. It is his duty to see that all parts of the mine are supplied with sufficient material and equipment. He is informed of supplies required by the foremen, engineers, and bosses, and by daily inspections of tool rooms and storage places. He orders steel, timber, powder, and general mine supplies every day for all parts of the mine. All these orders are filled and delivered on day shift. The routing of supplies is shown in Fig. No. 3.

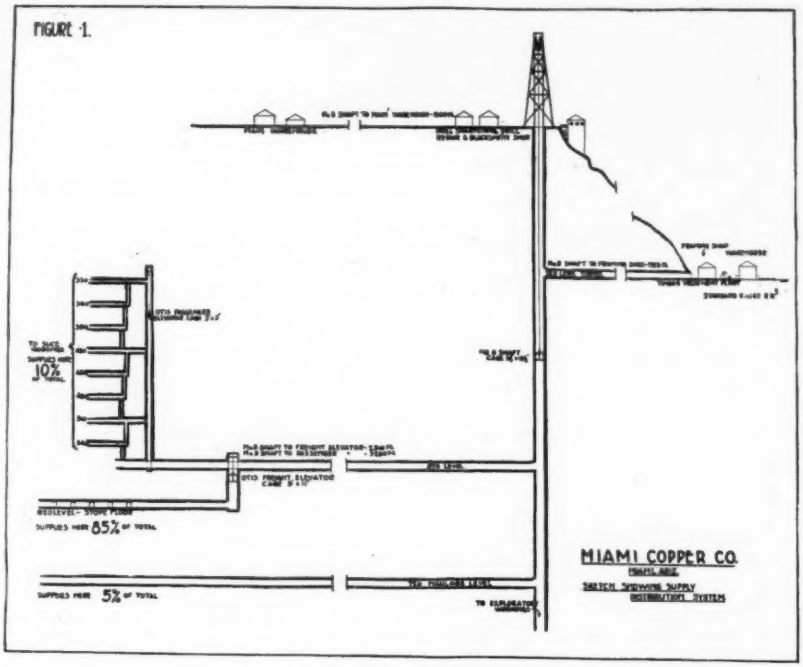
If a special tool or piece of machinery or specially designed set of timber is needed anywhere in the mine, the supply engineer is furnished with the necessary information, from which he makes up sketches for the shops or framing shed.

All mine equipment and supplies are ordered by means of requisitions on shops or warehouses. The supply engineer makes out all shop requisitions and assigns charge account numbers. Requisitions on the warehouses are made out by the mine office supply clerk. It is his duty to keep records of inventories of mine supplies, and to keep the mine superintendent advised of stocks on hand at all times. Other duties of the supply engineer are the testing out of new machines, and equipment and supervision of the salvaging work.

The personnel of the distribution organization is shown in the chart (Fig. 4), together with the schedules of operations for the mine supply trains. The supply engineer makes out the schedules and directs their operation. While all the members of the supply organization are not directly under the supply engineer, he supervises their work and is in large measure responsible for their discipline.

Transportation Equipment

Where large amounts of material are being transferred daily between the



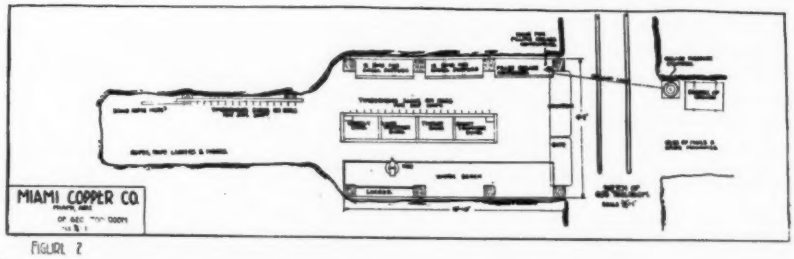
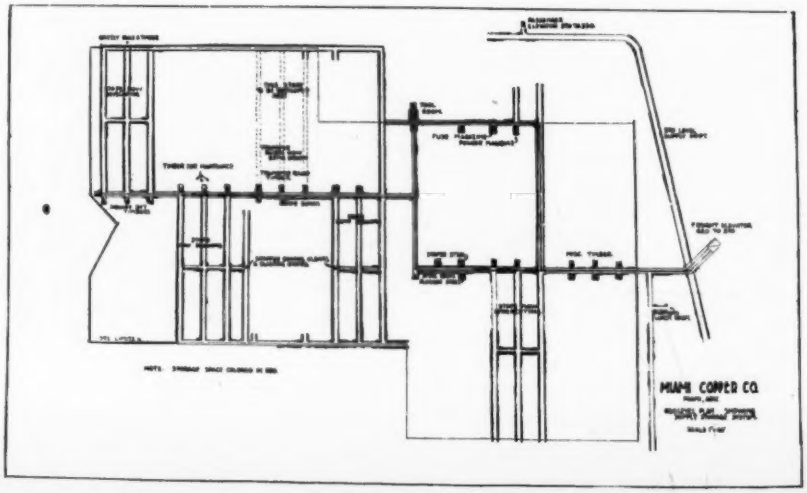


FIGURE 2



warehouses and shops on surface and the different underground workings of a mine, the gain in efficiency is considerable if the material can be transported to its destination without transfer from the vehicle on which it was originally loaded. At the Miami mine the track system on surface and in the main drifts underground has the same gauge which makes it possible to send most of the supplies from shop or warehouse to points very close to the places where they will be used without intermediate loading and reloading.

For lowering trucks of supplies to the 620 level from the 570 an Otis freight elevator of the common warehouse type has been adopted. It is believed that this is the first installation of its kind for purely underground use. This elevator is 5 feet wide by 11 feet long. It has a maximum load capacity of 8,500 pounds and travels at a speed of 50 feet per minute. Previous to this installation all supplies for the 620 level were lowered down a slide in an inclined raise. This method was inefficient because it necessitated reloading the material at the bottom of the incline.

Access to the sublevels above the 570 is facilitated by the use of a small elevator. Although trucks of supplies must be unloaded before being sent up from the 570 level on this elevator, it was more economical to install a small cage than to use a cage large enough to accommodate a 2-foot gauge truck as it is seldom that a full truck of material is consigned to any one sublevel. The smaller elevator has a speed of 100 feet per minute and serves levels which are from 30 to 240 feet above the 570 level. Its principal function is the transportation of men. Movement is controlled from a push button switchboard similar to those used in apartment house elevators. The passenger elevator is located north of the ore body, and the freight elevator in a waste pillar between the east and west halves of the orebody. The location of both is such that mining operations will not weaken the shaft pillars.

FIGURE 3.

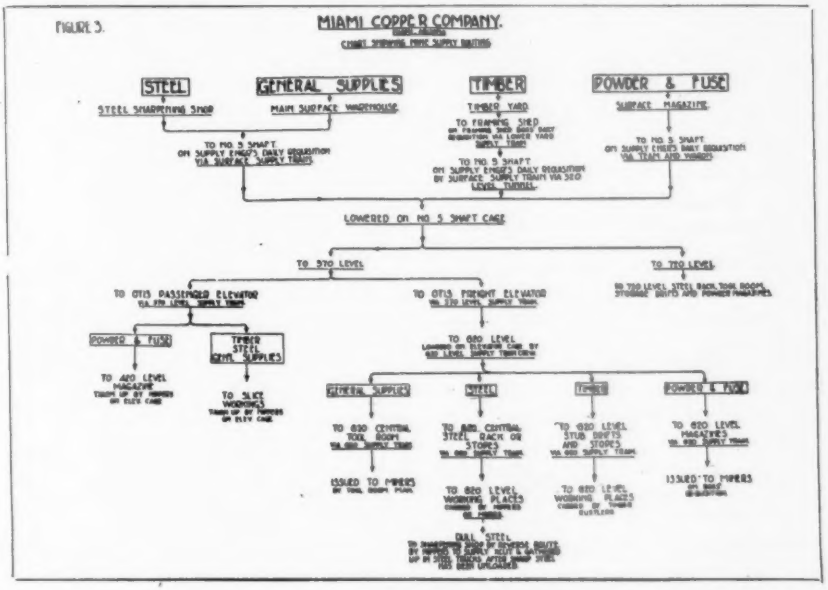
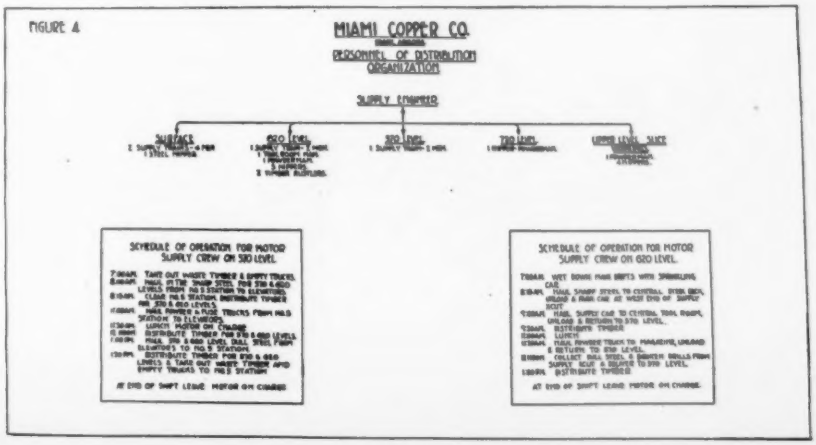


FIGURE 4



620 Level Distribution

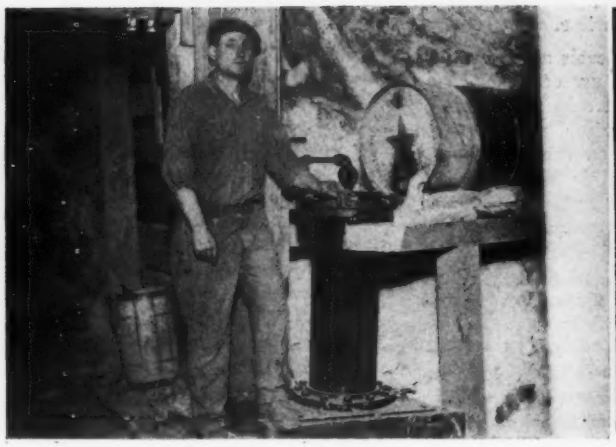
On the 620 level the main supply cross cut extends from the freight elevator across the orebody at its center. Branching from this cross cut supply drifts lead to the powder magazine, the fuse and cap magazine, and the central tool room. The supply cross cut is the center of activity on the 620 level for both mining operations and distribution of supplies. For hauling the trucks of supplies a small Mancha storage battery motor is used.

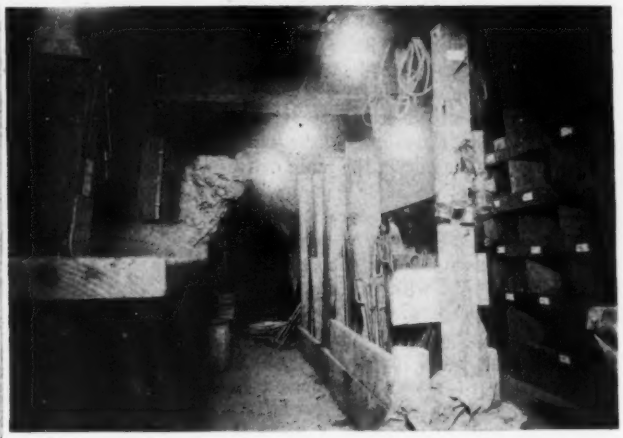
At right angles to the supply cross cut are a number of stub drifts 15 to 20 feet long which are used for the storage of timber, steel, and pipe. They are located at places where drifts will be driven later on in the course of mining operations, so the cost of driving them is not a supply distribution expense. Most of the stub drifts are used for the storage of timber and the name of the kind of timber that is to be kept in each stub drift is painted at the intersection of the drift with the supply cross cut. When the timber is framed and loaded on the truck in the framing shed a shipping tag stamped with the description and destination of the truck is tacked to each load for the information of the cagers and supply train crews.

It would seem that one timber station large enough to hold all the timber for the level would be better than a number of small storage drifts scattered over the level. Experience has shown, however, that the stub drift arrangement is the better. During the period when the grizzlies are being built in a stope the stub drifts near that stope are used for the storage of the stringers, spreaders, blocks, and rails that are used in the construction of the grizzlies. When the stope has been developed to the stage where square sets are being installed, the same stub drifts are used for storing the square set timber.

Powder and fuse are sent into the mine during the lunch period when other traffic is at a standstill. On the levels the powder trucks are hauled by a Jeffrey storage battery motor at a slow rate of speed. The powder man meets the powder truck at the shaft and works ahead of the train, carrying a red light. On the 620 level the powder magazine is located near the central tool room. It is the duty of the powder man to cut the fuse, crimp the caps and to issue the explosives to the miners on receipt of requisitions from the bosses.

The requisitions are of two kinds. One is printed on pink paper and is used by the boss when the miner is not to blast until given the word. This allows time for the boss to make special arrangements for guarding approaches and for intricate blasting of any kind. The other requisition is printed on





Left—Grease Pressure Cylinder, 620 Level, Central Tool Room. Grease is forced by air pressure from this cylinder to convenient locations for filling paper lubricant containers. Right—620 Level Tool Room

white paper and allows the miner to blast whenever he is ready.

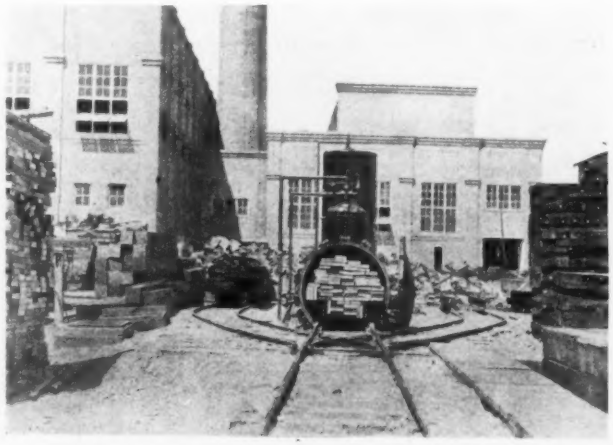
Central Tool Room

On the 620 level tools such as wrenches, saws, hammers, etc., are issued and charged to miners at the beginning of the shift and are checked in at the end of the shift. The checking is done by the man in charge of the tool room, assisted at the beginning and end of the shift by the nippers. When tools are issued to a miner, his number and the names of the tools he receives are written on a card. After all the tools have been issued the cards are arranged in numerical order so that the tools may be checked in without delay at the end of the shift. In order to provide the timbermen with individual sets of tools each set of timberman's tools is kept in a sack marked with the timberman's number. This sack is issued to no one but the timberman or his helper.

The location of the tool room can be seen on the 620 level map (Fig. 2). The wide section is 12 feet wide and 15 feet long. Twenty-four pigeonholes for small articles are built along the east side. In the center of the room is a rack for tools such as bars and double jacks. Along one side of the rack is a row of nails on which ropes, blasting wires, and the sacks containing the timberman's tools are hung. The drift at the back of the wide section is used for the storage of air and water hoses. The following is a list of the supplies and equipment kept on hand:

Oil cans.
Axes
Saws.
Levels.
S. jacks.
D. jacks.
Lamps.
Flash lights.
Short trammer bars.
Long trammer bars.
Timber bars.
Grizzly bars.
Water hose.
Air hose.
Scrapers.
String.
Tacks.
Tack hammers.
Seals (wire.)
Seals (tags.)
Pipe fittings.
First-aid supplies.
Wood chisels.
Rope.
Air augers.
Cold cutters.
Rope ladders.
Hack saws.
Blasting cables.
Blasting machines.
Goggles.
Wrenches.
Sacks.
Shovels.
Carbide.
Carbide containers.
Grease-dispensing machine.
Grease containers.
Hose repair outfit.
Hose-testing machine.
Electric tape.
Nails.
Nail pullers.
Cold chisels.

The tools issued to a timberman consist of a saw, axe, level and timber bar.



Timber Treating Plant, Showing Three-way Switch

A machineman receives a wrench, plugger hook and a tube of grease.

The grease container is a small paper tube from which the grease can be squeezed into the machine. The containers are filled at the central tool room from a pressure cylinder and are issued to the machinemen at the beginning of the shift. A tube holds enough grease to lubricate a machine for one shift.

All out-of-order machines are repaired in the surface repair shop and are sent into the mine each day with the sharp steel. Each machine is ticketed with its destination by the repairman. A chart, giving the company number of machine and the part of the mine to which it is assigned, is maintained in the repair shop for the guidance of the repairman. The supply engineer changes the assignments of machines from time to time in accordance with changes in conditions underground.

Although the tools are marked against the miner no charges are made for tools not returned. The tool man makes a report each shift to the supply engineer, who keeps a record of lost equipment. If any men are shown to be continually careless about losing tools, they are reported to the assistant superintendent or the foremen who administer discipline and impress the men with the importance of returning tools. In this way they are taught that they must take care of the tools issued to them if they wish to hold their jobs.

Most of the work in the mine is done on day shift, the work on the other two shifts being confined largely to (*Continued on page* 572)

MATERIAL HAULAGE AND HOISTING AT THE INSPIRATION CONSOLIDATED COPPER COMPANY

Economical, Safe And Rapid Handling Of Ore Calls For Careful Study In Original Installation —Kind Of Power Used Important Factor—A Description Of The Equipment And Method Used At This Efficiently Equipped Mine

By A. C. STODDARD*

THE subject of material haulage at a mining property covers a considerable number of items. The indispensable item, of course, is the handling of ore, for from this material must the profit be made to pay for the handling of all other items, such as waste and the various things that go to make up general supplies.

In the early stages of the development of the Inspiration property, underground movement of the broken rock and the hoisting of it were no different from most small mines.

The rock was trammed by man power in small cars, 20 cubic feet capacity, 18-inch gauge. The tracks were laid with light rail and were not so very well tied or spiked, for it seemed no particular trouble to get a car off the track.

These cars were trammed to small pockets at the various shafts and there dumped. One thing that has always been used in Inspiration rock movement is skips of various sizes, from two to thirteen tons.

The first shafts were two compartment and two compartments and a half. They were equipped with a skip with an underslung cage. The two compartment snafts had a counterbalance running in the ladder way and pipe compartment. They served the purpose of development and did it well.

After the mine had reached a little bigger stage in development, horses and mules were put underground and some two-ton rocker dump cars were used. With the installation of these cars, a track gauge of 30-in., later to become the Inspiration standard gauge, came into use. It is interesting to note, in this connection, that the first "wide" gauge to be laid on the 300-foot level was 36 inches. This is a wide gauge for the west, but seems to be quite generally used in the eastern coal mines and, as far as equipment is concerned, is much better than the 30-inch gauge, for 36-inch has been the standard narrow gauge throughout the United States.

After the animal stage had reached its limit, electric locomotives were used. This change was necessitated by the larger amount of ore needed for the test mill that was the pilot mill for the Inspiration concentrator.

It can be seen that the Inspiration was no different from most large properties in going through the usual stages of development.

As the development period was drawing to an end and the time for intensive production was in sight, the kind of haulage to be used underground had been selected and installed. This can be considered an original installation, for the haulage that was in use was changed in its entirety and the present system installed. This system has grown, but the original planning still holds its place.

The economical, safe and rapid handling of ore calls for very considerable study in the original installation of any method for the doing of this work. First, of course, comes the question of the kind of power to be used in the transportation of the ore. At the time of the planning and building of the Inspiration surface mine equipment and the planning of the underground haulage system, there were two types of haulage power to be considered, and I will say that at this date, for the service required at Inspiration, the same two types are the only ones possible for economical service. The choice then and now is only between electric trolley type locomotives and compressed air and as the electric power would have necessitated thousands of feet of bare conductor in the main haulage ways and in the gathering drifts, which are the only routes available for use by the men in going from the stopes to the shafts, and as this conductor was considered a source of danger, the compressed air locomotives were chosen. At that time, the power cost was taken as about equal. No doubt the question may be raised as to why storage battery locomotives were not considered. At that time, storage battery locomotives were in their infancy and, while at the present time they have passed that stage, we have just recently found out that at least our service is considered "very severe" for storage battery-trolley locomotives, so it would be almost if not quite impossible, to use a straight battery locomotive of reasonable cost and size.

On the surface, in the power plant, two high pressure compressors were installed, each having a capacity of 1,125 cu. ft. of free air per minute. This air is compressed to 1,000 pounds in four stages and piped underground for use.

The type of motor chosen was of H. K. Porter Company manufacture, with principal specifications as follows: Type, cross-compound with high pressure cylinder, 7 in. diameter with 14 in. stroke; low pressure cylinder, 14 in. by 14 in.; throttle pressure, 250 pounds; cu. ft. air capacity of tank, 105; number of drivers, four, and weight on drivers, 20,000 pounds. Charging pressure is 800 pounds. The haulage capacity per charge was estimated at 50 ton miles. The usual train is 20 cars of 102 cubic feet capacity per car, which gives a nominal capacity of five tons per car. Gross weight of 20 cars, as loaded, would be about 112 tons.

The ore cars chosen at that time were of the box type, mounted on four wheels running on brass bearings, and have no springs. Due to certain conditions that have arisen, we have changed a number of these box type cars into side dump cars for use at the Main Live

Concentrator, Inspiration Consolidated Copper Company, Inspiration, Ariz.

*Chief mine engineer.

Oak shaft in our haulage service on the twelfth level.

The length of the cars in use at Inspiration was governed by the loading chute interval. This interval was 25 ft. and the center to center of coupler length of an Inspiration car is 8.4 ft. This made every third car in a train come under a loading chute, which is a material help in rapid loading. The width and height are governed more by the size of the haulage way though the convenient height and slope of the loading chute has some influence.

The trains when loaded with ore at the Inspiration division are hauled to either the Main East or Main West tipple on the sixth level, and are dumped into a pocket at either shaft by electrically operated tipples which dump five cars at a time. The tipples installed here are, after ten years, still giving good service. They have been replaced and repaired, but the original idea of installation has never been changed.

The tipples are each driven by a 35 horsepower motor and make a complete revolution in 15 seconds.

There is no question that a tipple is a safe and, under certain conditions, a rapid method of getting rock from cars into a pocket. There are certain human factors, however, that must be taken into account. The tipple operator must have a fair amount of skill in handling his machine. The automatic alignment stops never worked for any length of time on the Inspiration installation, so the exact stopping of the tipple for the track alignment is dependent on the skill of the operator. Inasmuch as the Inspiration type of tipple calls for the separation of the cars on the tipple from those off the tipple, the motorman of the train has to use skill in the spotting of the cars on the tipple. The cars on the tipple must be at rest or nearly so before the rest of the train is uncoupled and pulled away. The main advantage of a tipple is in the use of a box type car which type gives the most ore capacity per car unit, as compared with the weight of the empty car.

At the Main Live Oak at the twelfth level station, a six car, air-operated tipple was installed but, due to inherent defects, this tipple was discarded and replaced by a bridge over the pocket. The type of car had to be changed to side discharge. Box type cars were made over into side dumps with a nominal capacity of 3.4 tons. Due to this type of car being more easily kept clean than the box type, it is found in haulage that the 3.4 ton car actually averages around 3.2 tons, while the 5-ton car averages around 3.6 tons. This difference in haulage capacity is especially noticeable with Live Oak ores, which readily pack in the cars and in the box type cars, the bottom builds up rapidly. Chains are fastened, which swing loosely inside the box type close to the bottom in order to prevent as much as possible this building up, and with some classes of ore the scheme works well.

With the rather heavy ore trains that are operated, and, in normal times the number of trains that are used every shift in the day and usually every day in the month, a well laid track is an essential requirement. Inspiration standard weight of rail has been 40 pounds, but on a long haul that we expect to have in service in the next year, we expect to use a 60-pound section. A mine track is always a difficult job to hold in alignment, and a heavier rail section should be of material help.

The usual size of tie is 6x8 inches, 5 feet long, which is sufficient for our track gauge of 30 inches. They are spaced 24-in. centers. We have used plain fir and creosoted pine, but at present are trying out Port Orford cedar. As yet, we have not sufficient data available to make a comparison between the creosoted and cedar ties.

It is usual to ballast mine tracks with any material available. However, we have found that good ballast is a material help in keeping a track in good shape, so are using broken slag from the smelter in many places where a soft bottom made it difficult to maintain a good track, and find that there is considerable saving in maintenance, and above all a well tied and ballasted track is a big help in lowering operating costs, in that derailments are few. A train off the track in such a mine as Inspiration means not only interrupting the hauling of ore from one stope, but if the derailment is on the main line other trains are also delayed. Delay in transportation soon delays production all along the line.

At the Inspiration Division, where exceedingly heavy tonnages for underground mining have been handled in a day, this tonnage has reached 22,500 tons in 24 hours, a large number of trains have been required, this number running as high as 12 units on the sixth level. This meant a train out or in to one of the tipple terminals about every three minutes. Traffic such as this necessitates some sort of a dispatching system in order that either terminal might not be overcrowded. Each terminal has a capacity of five 20-car trains and it is possible that each terminal could have its capacity and unless other trains were stopped from entering, considerable confusion would result.

In order to avoid this confusion, soon after haulage was commenced on the sixth level an automatic block signal system was installed. The system is an adaptation of the standard equipment used for high speed surface railroad traffic. All equipment was furnished by the General Railway Signal Company, of Rochester.

The level is divided into a number of blocks. At the ends of each block and at other prominent points on the main lines, signal lights are placed. On curves from the main lines, signal lights are also placed in such position that main line trains are protected and trains on these curves from other trains backing into them. Protection in all cases has been the constant endeavor. Protection means safety for the men operating the trains and fewer interruptions of train movement, thus increasing production per unit. In addition to the signal system, there is a train dispatcher stationed at the place where the main lines from the east and west sides of the mine join. This junction is the throat of the Inspiration haulage system. The dispatcher controls the routing of the trains to either the Main East or Main West terminals.

At this junction, there is a switch interlocking machine which is operated by the dispatcher. This machine controls the switches most in use between the operator and the terminals. The mechanical operation of the track switches also controls the operation of the lights of the block signal system. In addition to the block signal system, the dispatcher has independent means of signaling the trains to stop or proceed. At Inspiration nearly every device and every effort has been used to make the ore haulage problem as safe as possible. One thing is left, however, that can not be controlled as well as the mechanical part of the work, and that one thing is the human element. Always there seems to be motormen or helpers that will take a chance or violate the rules that they know were made for their safety, and in many instances this chance taking leads to the injury of someone or to the interruption of traffic. Strict discipline checks the tendency, but as long as the necessity for work exists, it can never be overcome.

We have taken up in some detail the handling of the ore trains, but there is another part of the operation of a mine that needs transportation. If supplies could not be transported with reasonable dispatch, the transportation of ore would be considerably curtailed. As in most operations in industry, correlation of the various operations is necessary for a harmonious whole.

If the statement is made that the Inspiration used about 1.1 board feet of timber per ton of ore won from stoping operations it seems a small amount, but when the statement is made that over 3,000,000 board feet were transported into the mine and used in the first six months of 1925, it can be seen that this is some transportation in itself.

To safeguard this essential item a stock of around 4,500,000 feet is kept on hand.

The cars of timber are switched to a spur track in the tunnel yards and unloaded onto trucks which can be sent to the storage piles, the timber framing shed or directly into the mine.

The movement of supplies is facilitated, since trucks loaded in the yard do not have to be unloaded until they reach the storage places underground.

The tunnel yard is connected by a tunnel with an inclined shaft, which in turn connects with the various working levels of the Inspiration Division and the tunnel by means of bridges which can be raised and lowered.

Supplies for the Live Oak Division are hauled through the various connecting drifts on the sixth level to the places of use or storage on the sixth level. However, if they are to be used on the twelfth level or above, they can be moved without unloading from the trucks to the twelfth level on the cage which operates in the Main Live Oak Shaft, or unloaded and sent down on the cage in the Live Oak No. 2 Shaft.

Powder, fuse, caps, steel and most miscellaneous supplies are handled in a similar manner.

Carbide is about the only article of supply that is handled by surface transportation. As this article is needed by the men before they go on shift, the supply is carried at the various change houses, from which the men enter the mine.

Having described in considerable detail the handling of materials underground and having brought them to the bottom of the shafts, a description of the various hoisting shafts of the company should follow.

At the Inspiration Division, hoisting of ore is done through two shafts, 102-foot centers apart. These shafts are of usual design, each having three compartments in line; each compartment being 5 ft. 6 in. by 5 ft. 11 in. In each shaft two compartments are used for the hoisting of ore. In one shaft, the West, one compartment is given over to the Otis elevator for the transportation of men. In the East shaft, one compartment is given over to the counterbalance for the elevator as well as to the ladder way, pipe and conduit ways.

The speed of these hoists is approximately 750 feet a minute, and the distance from the chairs under the loading pocket to the dump is 630 feet in each shaft. This travel in the East shaft will be increased by over 200 feet when hoisting is started from the eighth level.

The hoists for the ore can be, and usually are, automatic in their operation, each hoist controlling through connecting mechanism the operation of the other. The skips in use at both these shafts and the Main Live Oak are identical in size and have a capacity of 12 tons. The hoisting capacity of the shafts, with automatic operation, is 900 tons per hour, but by using hand operation, the tonnage hoisted in one 24-hour period reached 22,500 tons.

At the Main Live Oak Shaft conditions to be handled were very different from those at the Inspiration. The first ore horizon to be mined was 1,200 feet from the surface and was 600 feet below the lowest, or 600 level of the Inspiration, which level is the only connection between the two divisions of the property.

This condition necessitated the Main Live Oak Shaft, an entirely new shaft, 1,400 ft. deep. The hoisting compartments are of the same size as at Inspiration and the skips are interchangeable. The man cage is of single deck construction, and travels in a compartment 12 ft. 4 in. by 6 ft. 9 in. This allows a cage of sufficient size (5 ft. 7 in. by 11 ft. 10 in.) to handle nearly all supplies to be handled with transfer from the supply trucks. The mine ore cars can be handled from and to the surface or from level to level. The manway compartment is 2 ft. 9 in. by 12 ft. 4 in. and in this compartment is the space for the cage counterweight, as well as the ladder way, pipes and conduits.

The ore hoist is first motion, with double drums 12 ft. in diameter by 8 ft. face. Both drums are grooved for one layer of 1⅞ in. rope, 1,700 ft. long. The rope speed is 1,830 ft., and 600 tons can be raised from the twelfth level per hour, the hoist running automatically, being started by the operator on the loading floor. It can also be operated from the hoist platform.

The cage hoist is second motion with a single drum, 10 ft. in diameter, with 8 ft. 6 in. face grooved for 1,468 feet of rope and carries two 1½ in. ropes in a single layer, the overwound rope operating the cage and the other a counterweight. The hoist has two speeds of operation, one 800 ft. per minute for handling men and one of 1,500 ft. per minute for handling waste and supplies.

The designing of equipment, both underground and on the surface, has been done by Inspiration's engineering staff. The underground transportation system has been planned and carried on by the mining department.

Equipment has been furnished as shown in the chart on this page.

The paper here submitted for your consideration gives an idea of methods and means of handling materials at the Inspiration Consolidated Copper Company. It is brief in many ways, but if details were attempted, each operation would call for a paper of considerable length.

SOURCES OF EQUIPMENT

	Inspiration Division	Live Oak Division
Headframes	American Bridge Co.	Kansas City Structural Steel Co.
Sheaves	Wellman-Seaver-Morgan Co.	Wellman-Seaver-Morgan Co.
Hoists, Ore	Nordberg-General Electric Co.	Nordberg-General Electric Co.
Hoists, Man	Otis Elevator Co.	Nordberg-General Electric Co.
Compressors, Low Pressure	Ingersoll-Rand Co. Nordberg Mfg. Co.	Ingersoll-Rand Co.
Compressors, High Pressure	Ingersoll-Rand Co.	
Tipples	Wellman-Seaver-Morgan Co.	Car Dumper and Equipment Co
Hoisting Ropes	John Roebling Sons Co.	John Roebling Sons Co.
Skips	Company Shops	Company Shops
Skip Loaders	Company Shops	Company Shops
Air-operated Bin Gates		M. H. Treadwell Co.
Mine Cars	Mt. Vernon Car Mfg. Co.	Koppell Industrial Car & Equipment Co.
Air Motors	H. K. Porter Co.	H. K. Porter Co.
Mine Signals	Gen Railway Signal Co.	General Railway Signal Co.

WESTERN DIVISION MEETING

(*Continued from page* 525)

Arizona. Those coming over the Santa Fe will leave the train at Phoenix and automobile buses will meet all trains on Monday, November 16, and will take the delegates directly to the San Marcos Hotel. Persons coming to the meeting over the Southern Pacific System can leave the train at Chandler where buses will take them to the hotel.

This western mining conference is of value and interest to all men interested in the further development of the metal mining industry. It presents an opportunity for cooperative action and for informal discussions of problems and policies. In addition, it furnishes a rare opportunity for a delightful renewal of acquaintanceships and friendships, as well as to enjoy a wonderful trip through Arizona and the inspection of some of the greatest copper mines in the world. It is an event which will mark another milestone in the development of the work of the American Mining Congress in safeguarding and stimulating the further development of western metal mining interests.

Arrangements have been made to start immediately the preliminary work necessary to electrify the main line of the Pennsylvania Railroad's southern division from Philadelphia to Wilmington. All the telephone, telegraph, and signal wires will be placed underground. Their removal is required to make way for the steel poles and overhead copper conductors that will carry the current for electric train operation.

TRANSPORTATION AND HANDLING OF ORE AND WASTE IN THE MAGMA MINE

A Description Of The Method Used At The Magma Copper Company's Property In The Handling Of Materials Underground, Together With A Description Of The Equipment Used

By FREDERICK W. SNOW*

THE Magma ore bodies occur as shoots in a fault fissure vein having a strike of about north 80° east, and a dip to the south of approximately 78° with the horizontal. The vein varies in width from 5 feet to 60 feet.

The present output of the mine, which is around 650 tons per day, comes from an ore shoot having a length on the 1,800-foot level of 1,600 feet.

Development drifts and haulage drifts are driven parallel to the vein in the footwall, at about 20 feet from the vein, and from these drifts crosscuts are driven through the vein at intervals of 150 feet.

SHAFTS AND SHAFT EQUIPMENT

The mine is served by two main hoisting shafts, No. 2 shaft which is in the footwall of the vein, and No. 3 shaft which is in the hanging wall of the vein 800 feet south of No. 2 shaft. Fig. 1 is a plan of the 1,800-foot level showing relative positions of shafts, haulage drifts, crosscuts, etc., with relation to the vein. Both shafts are three-compartment shafts, having two skipways and a manway.

The skip compartments in No. 2 shaft are 4 x 4 feet in the clear, and the manway is 4 x 3 feet in the clear. All three compartments in No. 3 shaft are 5 x 4 feet in the clear.

Shaft pockets having a capacity of approximately 125 tons each are cut on all haulage levels, and are equipped with air doors and with loading cartridges holding exactly one skip load. The capacity of the skip in No. 2 shaft is 2½ tons, and in No. 3 shaft it is 3 tons. Branch pockets are cut in No. 2 shaft, and by means of diverting-doors two different products are handled. The diverting doors at the collar of the shaft are controlled by the hoist engineer, and at the bottom by the skip tender. Arc type air doors, operated from above, are installed on all shaft pockets and on most of the large gathering raises where motor trains are used.

From No. 2 shaft levels are driven every 100 feet down to the 2,000-foot level, and from No. 3 shaft every 400 feet.

No. 2 shaft is equipped with a Nordberg double-drum geared electric hoist. The drums on this hoist are 5 feet in diameter by 36 inches smooth space. The hoisting rope is 1 inch in diameter, with six strands regular lay of 19 wires each, and has 10,350 pounds rope pull. The speed of this hoist is 750 feet per minute, driven by a 250 H.P. Westinghouse motor.

No. 3 shaft is equipped with a Nordberg double-drum hoist. The diameter of drum is 7 feet, and has a winding face of 72 inches. There is a gearing arrangement through single reduction of herringbone gears to a 400 H.P. 500 R.P.M. Westinghouse motor. The hoisting rope is 1¼ inches in diameter, with six strands Lang lay of 19 wires each. The rope speed is 1,000 feet per minute.

The main working tunnels connect with the 200-foot level and the 500-foot level of both shafts.

Direct smelting ore is hoisted through the No. 2 shaft to a large ore pocket on the 500-foot level. From here it is hauled through the 500-foot level tunnel out of the mine to receiving bins located on a spur of the broad-gauge railroad.

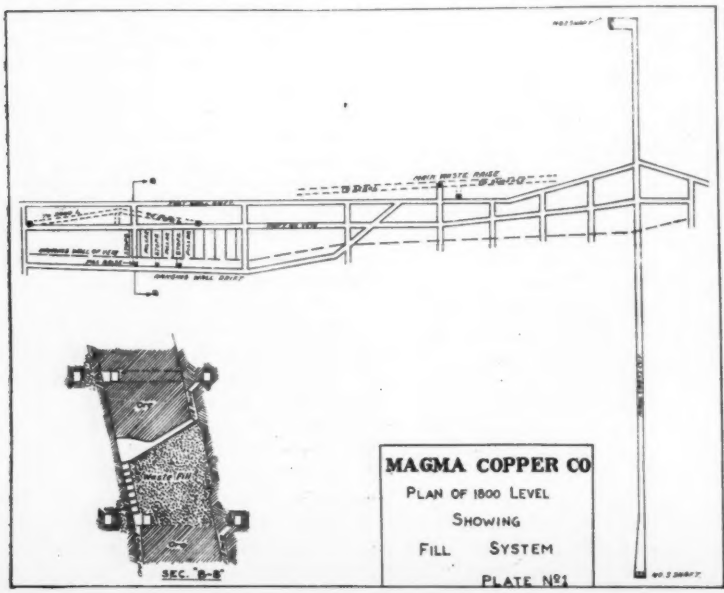
Waste rock from development is also hoisted through No. 2 shaft to the 200-foot level, where it runs by gravity through an incline raise to the main incline waste raise. This latter raise is the waste rock pass from the surface glory hole, where the filling for the stopes is mined, to the 2,000-foot level.

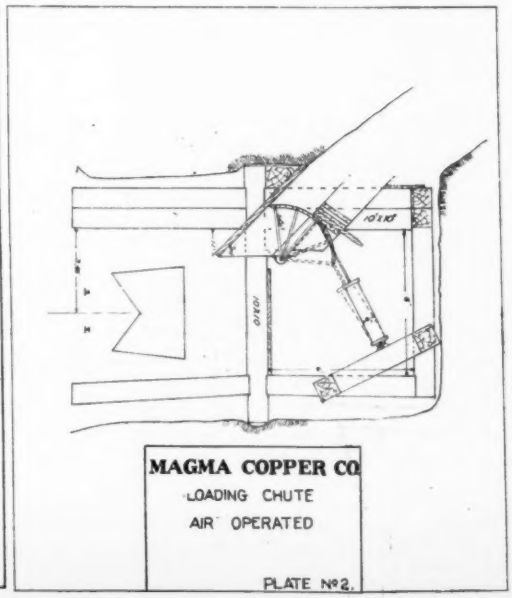
All milling ore is hoisted through No. 3 shaft to the 200-foot level. From here the milling ore is hauled through the 200-foot level out of the mine to receiving bins at the head of an aerial tramway, which in turn conveys the ore to the mill, a distance of approximately half a mile.

LOCOMOTIVES AND TRACKS

Both storage battery and trolley locomotives are used in the transporta-

*Mine Superintendent, Magma Copper Co.





tion of ore and waste. The storage battery type can be described as Westinghouse Class A-62 four-ton, equipped with two ball-bearing 80-volt motors and steel-tired wheels. The battery for these motors consists of 80 Edison No. A-5 cells of 18 K.W.H. capacity. The drawbar pull rating is 1,000 pounds at 3½ miles per hour. The locomotives are equipped with half-size M.C.B. automatic couplings. The couplings are 14 inches above top of rail.

The trolley locomotives are 3½-ton Baldwin - Westinghouse Steel Frame, equipped with half size M.C.B. couplings 14 inches above top of rail. Drawbar pull is 1,750 pounds at 4.4 miles per hour with dry rail and rated voltage at trolley.

Both types of locomotives are of 18-inch gauge.

In the 200 and the 500-foot level tunnels, and underground, all motor track is 18-inch gauge, of 30-pound rail, laid on 6 x 6-inch Oregon Fir ties, placed at 2½-foot centers. Around all curves guard rails are used on the inside rail, beginning at the frog. The switches are of the stub type, with a No. 3½ frog, made of 30-lb. rail riveted to quarter-inch steel plate. The bonding is done on track and switches with No. 0000 26-inch flexible rail bonds. No. 0000 grooved trolley wire is carried by hangers spaced approximately 20 feet apart, and at least 7 feet 6 inches above the tie. Direct current of 125 volts is supplied by two motor-generator sets, one located in No. 3 shaft hoist house on the surface, the other on the 1,600-foot level at No. 3 shaft pump station. Where trolley wire passes under loading chutes, a box made of 1 x 8-inch lumber, 8 inches wide, protects the loader from contact. Fig. 2 is a side elevation of a standard chute layout, and shows the position of chute tapper, door, air cylinder, etc.

For hand tramming, the track used is 12-pound rail, laid on 4 by 8-inch ties spaced at 2½-foot centers.

Underground Ore Haulage

Trolley locomotives are used on the 2,000-foot level, which is the main extraction haulage level at present. The haulage drifts are approximately 8 by 8 feet, run on a 0.5 percent grade, the loaded train having the advantage of the grade. All curves in the mine ranging from 30-foot radius to a 50-foot radius curve.

As a measure of protection to men walking through the haulage drifts, a signal system has been installed consisting of red and white lights. The red lights are turned on and off by the motorman at the beginning and end of a trip, both at the shaft pocket and at the transfer raise inside.

Gable-bottomed cars of two tons capacity, or 40 cubic feet, are used for transportation of ore both underground and on the surface. These cars are equipped with Hyatt roller - bearing wheels. A train is made up of 10 cars. Underground the train crew consists of motorman, a brakeman and a chute tapper. Two train crews, each working 8 hours, haul the output of the mine with great ease.

Large incline gathering raises, with branches, are run from the 2,000-foot level to the stoping levels above, the object being to eliminate as much as possible hand tramming. The positions and number of gathering raises are determined by the cost of hand-tramming the ore from any portion of the vein, figured against the cost of the raise in question. All the stopes in the mine produce at irregular times direct smelting ore, and because of this most of the direct smelting ore is necessarily hand trammed. A large ore pass from the 2,000-foot haulage level to the different stoping levels above is reserved for storage of this grade of ore.

The average length of haul on the 2,000-foot level is about 1,200 feet.

In the past all cars used for hand tramming were of 14 cubic feet capacity, end-dump type, a turntable being provided to enable the trammer to dump on the side when necessary. This car never proved very satisfactory, being rather top-heavy, and expensive to keep in repair. Recently a 14-cubic-foot side-dump car, a type used by the United Verde, has been adopted, and the end-dump cars are being eliminated as fast as possible.

Fig. 3 is a longitudinal section of the mine, showing the position of the haulage drifts, gathering raises, and stopes.

Underground Waste Haulage

Waste haulage levels for motor trains are developed every 200 feet. The main waste rock raise from the surface glory hole has drawing-off chutes on all the stoping levels below the 1,300-foot level, the 1,600-foot level being the main waste fill haulage level at the present time.

Storage battery locomotives are used for hauling waste fill.

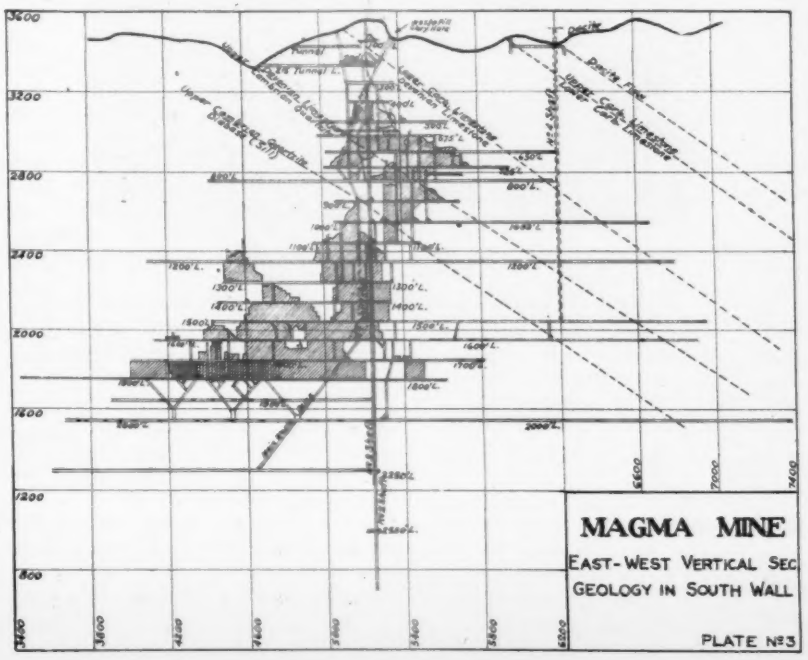
Haulage drifts 7 x 6 feet are driven in the hanging wall of the vein at a distance of 10 feet from the vein. Waste raises from the stopes below are driven in the hanging wall on the wall of the vein to connect with this waste haulage drift or hanging wall drift. Eighteen-cubic-foot side-dump cars, equipped with Hyatt roller-bearing wheels, are standard equipment for this work, and 8 to 10 cars are used in each train. The train crew for waste fill consists of a motorman, a loader and a brakeman.

200 Level Tunnel Haulage

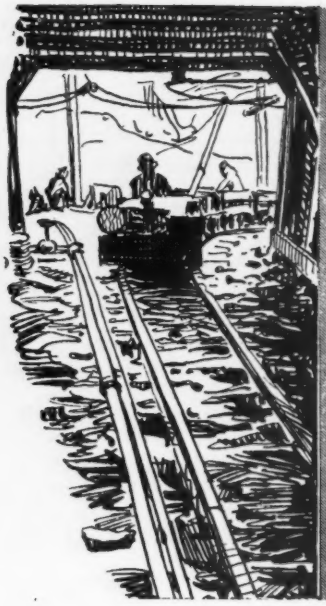
Electric trolley locomotives are used to haul the milling ore from the No. 3 shaft pockets to the tramway receiving bins, a distance of about 1,000 feet. Ten gable-bottom cars, of 40-cubic-foot capacity each, are used for this haul. One crew of two men, a motorman and a brakeman, handle up to 800 tons during an eight-hour shift.

500 Level Tunnel Haulage

Storage - battery locomotives are used in the 500-foot level tunnel. All direct smelting ore, limestone for the smelter, all mine supplies, are handled through this tunnel. Three crews of two men each, a motorman and a brakeman, are required for the work.



(*Continued on page* 571)



COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Coal Mining Industry

MINE TRACK WORK AND MATERIALS

Materials Should Be Designed To Suit Transportation Equipment—More Important Considerations Include Axle Loading, Wheel Bases And Wheel Design Of Locomotives And Cars—Speed Of Trains, Roadbed, And Clearances To Be Observed

By AMOS A. CULP*

THE transportation system is the neck in the bottle of a mining operation, regulating the flow of the raw material from the working faces to the tipple. While the track costs are a relatively small percentage of the total mining costs, all other items are directly affected by the transportation facilities.

In order to obtain a haulage condition which will minimize the total of all cost items, a careful study must be made of the transportation system, the track materials and track construction and maintenance methods.

The planning of the track system, with its main and secondary haulages, yards and side tracks, can only be done properly by taking into consideration the methods of mining, the present and future production from each section of the mine, the kind and capacity of haulage equipment and other special conditions.

If carefully planned, a minimum of traffic congestion, fewer delays, a better car distribution, and a more uniform operation will result. Less equipment will be required to handle the same amount of material.

This protograph gives an excellent example of the lack of track standards.

Evidently the switch stand was designed for a different throw from the switch itself. The trackmen were probably not equipped to redrill the head rod, so they attempted to make the neccessary adjustment by putting washers between the clips and the switch points.

Treads of locomotive wheels were allowed to wear down past the safe limit before being changed. The wheel surface directly over the narrow rails became worn to the point where "false" flanges were created on the outside edge of the tread and the true flanges become deeper. The results are seen in the wear on the tops of the clips by the true flanges and the groove cut in the left hand stock rail by the false flanges.

It is probable that the tops of the clips were not low enough to start with.

TRACK MATERIALS

Because mine officials are not railway men and lack in most cases the experience necessary to design their own materials, comparatively few companies have gone into standardization. As a consequence, bad track conditions arise, from the use of materials improperly selected and designed, parts are not interchangeable and each job is a new problem for the track foreman.

The materials should be designed to suit the transportation equipment. The axle loading, wheel bases and wheel design of locomotives and cars, the speed of trains, roadbed conditions, the gradients and clearances to be observed, are some of the more important considerations.

RAIL

In selecting rail sections for various traffic conditions the axle loading is the governing feature. The size and spacing of cross-

*Consulting Engineer, Birmingham, Ala.

These photographs show a turnout for motor haulage constructed with well designed frogs and switches. It will be noted that sawed switch ties are used which give a better bearing and insure a better fit of the materials. Slide plates are used on every tie under the points. The base plate of the frog is large enough for ample riveting and provides a good bearing for the frog on the ties.

ties and the condition of the roadbed must also be taken into account.

Cross-ties should not, as a rule, be spaced closer than a shovel width apart. This allows sufficient room for tamping and facilitates the renewal of ties. If the roadbed is dry and the ties well tamped, a lighter rail can be used than when the conditions are the reverse.

It is economical to use heavier rail than is considered absolutely necessary. The track will not "spread" as readily and the rails are not so likely to become "surface bent" from the improperly tamped ties. Some years ago the Lehigh Valley Railroad found it necessary to use heavier rail. A section weighing 136 pounds per yard was adopted, and it was found that not only were maintenance costs reduced but the yearly tonnage of rail renewals became less.

Rails in most general use in the mines are either the designs of the American Society of Civil Engineers or the American Railway Association. Recognized standard designs should be used by the mining companies and drawings made showing the sections with the necessary drilling, punching, bolting and slotting data for both rails and splices. Each order for rail or splice bars should refer to these drawings so as to save writing lengthy descriptions and to insure the purchase of material of the same design as on previous orders. The drawings will give the trackmen all the data they may need for identifying sizes of rail and will show them the size of bolt to use for each rail section. It will give them the spacing and diameter of any holes they may have to drill.

Turnouts

The turnout plans should be worked out at the same time the general dimensions of the frogs and switches are determined as the theoretical length of lead and the radius of the turnout curve are fixed by the frog and switch angles and lengths. The lead should be such that with a given frog and switch design, the longest possible turnout radius will be obtained. The radius ought not to be shorter than the minimum radius allowed for operation of the same class of equipment over curved track at other points.

Illustrating a poor frog design. The point rails became loose because of insufficient rivets and lack of proper splicing at the joints. Full length splices are shown on the outside of the short point and on the inside of the long point. There was not sufficient room for a full length splice on the inside of the short point and only one bolt could be used. This caused an undue strain on the rivets by the action of traffic.

The joints at the toe were not full bolted for the same reason. The wing rails were not long enough to provide the clearance necessary for the full splice length and the insertion of the bolts.

The effect of badly worn locomotive tires is seen again in this photograph. Grooves were cut across the wing rails by the "false" flanges.

The plan of the turnout should show the lead length; angle, number and length of frog; heel spread, angle and length of switch points; length of rails connecting frog and switch; radius and ordinates for bending the curved connecting rail and the dimensions and spacing of the switch ties. This will give all the data required by the engineers and track men for proper installation and by the purchasing agent for ordering the switch ties.

Turnout Materials

In addition to the effect of the general dimensions of the frogs and switches on the turnouts, there are a number of things to be considered in working out their detailed designs.

The spread of the point rails at the heel and of the wing rails at the toe of the frog need only be great enough to allow for the use of full length angle bars and the insertion of the track bolts. The same is true of the spread from the stock rail of the heel of the switch point. This rule fixes approximately the total length and the proportion of its toe and heel

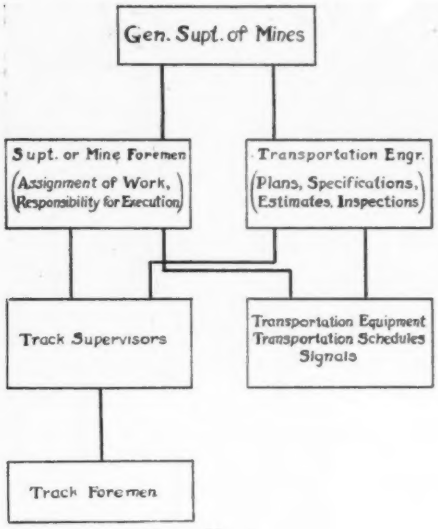


Chart No. 1

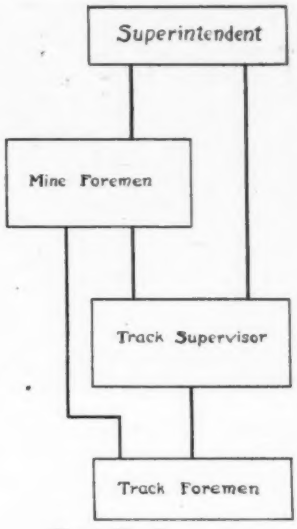


Chart No. 2

lengths, of a frog of any number and rail section. Likewise it fixes approximately the angles of switch points of various lengths:

The depths of wheel flanges plays an important part in the design of frogs and switches. The flangeway through a frog must be deeper than the wheel flange unless the frog is designed so that the wheels will pass through carrying the load on the flange instead of the tread.

Fabricated frogs made of rails weighing less than 60 pounds per yard are generally of riveted plate construction, as filler blocks through which the point and wing rails can be bolted together will not leave sufficient flangeway depth. This type of frog is held together mainly by the rivets fastening the rail bases to the base plate. The strength of the frog is dependent on the number and size of rivets so the plate must be long enough to provide ample riveting area.

The top of the clips which fasten to the switch points and hold them together by means of the head rod, must be sufficiently low from the top of the rail to prevent being sheared off by the flanges. It is desirable to bolt the clips to the points in order that either may be renewed without changing the other. If the head rod is welded or riveted direct to the points, the entire switch must be taken out for failure of any part.

The spread of the switch heel from the stock rail being fixed approximately as stated above, the length of the switch point is determined by the angle desired. It is customary to make this length an even divisor of 30 feet which is the standard length of light rails. As the bolts in the splice bars at the heel must be loose enough to allow the point to be thrown to the open or closed positions, it can readily be seen that the longer the point, the tighter the bolts may be made.

Slide or friction plates, under the points, insure a better fit to the switch rail, make the switch throw more easily and protect the ties from mechanical wear.

Manufacturers standards are generally adopted, even by the railroads, as their own standards for switch stands. The two types in general use in the mines are the right angle "ground throw" and the parallel "ground throw." The lever of the former operates at a right angle to the track while the latter throws parallel with the track. The parallel type is usually the more expensive but is considered safer as the operator does not have to stand so close to the track when throwing the lever.

The distance the switch points are to throw must be specified when ordering the stand, otherwise unnecessary drilling and bolting of the head rod is necessary to make the points fit properly.

Organization and Instruction of Track Forces

The charts above show recommended plans of organization.

Chart No. 1 is for companies operating electrified mines with large production.

Chart No. 2 is for companies operating several mines with small production and little track work.

Supervisors are recommended because the mine foreman's varied duties prevent him from devoting a sufficient amount of time to supervision of the track work. If detailed to various foremen of mine sections, the track men have too many bosses, each with different if any ideas about track and consequently good results are not obtained. On the other hand, the supervisor can distribute men and materials most economically and can see that everything is done in accordance with the plans.

Unless the track foremen are thoroughly familiar with the plans, specifications and designs and realize their importance, the work will not be properly executed. It is an excellent plan to hold periodic meetings, at which time general instructions in materials, layouts and methods can be given. Discussion can be encouraged and many valuable suggestions will be made. At such meetings final cost data on jobs done by the various foremen can be read and a spirit of friendly rivalry for better track and costs will result.

The question of tools should be given considerable thought. Best results can not be expected unless the foremen are supplied not only with the proper materials and instruction but also with an adequate number of tools for each class of track work.

Results of Standardization and Organization

Competent study and planning of the transportation system will have a decided effect on practically all the items of mining cost. As stated before the greater train speeds, fewer delays from wrecks, less traffic congestion, better car distribution and greater production will all help in the general reduction.

The track costs will be lowered because parts will be interchangeable, saving unnecessary labor and material; material will be more economical because especially designed to suit conditions; and track forces will build better track in less time because their materials, layouts and methods are standardized. Track will be properly constructed and will require less maintenance.

SAND AND GRAVEL IN 1924

THE output of sand and gravel in 1924 from plants in the United States, as reported to the Bureau of Mines, amounted to about 156,527,967 short tons, valued at $97,241,641. This was an increase of 12 percent in quantity and 7 percent in value over the production reported for 1923.

Seven States shipped over 10,000,000 tons each—New York, Indiana, Illinois, Michigan, Pennsylvania, California, and Ohio, in the order named, New York shipping 13,397,540 tons and Ohio 10,379,361 tons. Pennsylvania led in value of output, its shipments being valued at $10,927,752. New York, Ohio, Illinois, California, Michigan, and Indiana followed in the order named, the output of Indiana being valued at $5,070,339. Many other States showed increases. The average value per short ton was 62 cents, as compared with 65 cents in 1923.

THE NATION'S VIEWPOINT

A Digest Of The Expressed Opinions Of Leaders In American Affairs

HE failure of the miners in West Virginia to respond to the strike call issued by the United Mine Workers of America caused only a wave of the mildest surprise in the public press. The entire apathy of the consuming public to the coal situation with its strikes and threatened strikes is mirrored in the general editorial comments of the press. *Black Diamond*, of Chicago, states that the only result that Mr. Lewis could obtain through calling out the entire membership of his organization would be the newspaper publicity, and editorially points out:

"The calling of the second strike in the West Virginia fields by John Lewis and the failure of the miners to quit work clearly demonstrates the gradual weakening of the United Mine Workers of America, both in membership and morale. The firm stand of the anthracite operators, the inability of the large producing units throughout the Central Competitive Field to sell their product operating on the Jacksonville scale, and the vast increase in tonnage from the nonunion fields has placed the Lewis organization in a precarious situation. The final outcome, no one can foresee at this time.

"It is an absolute certainty that the anthracite producers can not and will not recede from their position. If Lewis is unable to win the anthracite strike, coal producers on the border line between the union and nonunion districts will insist on an immediate revision of the Jacksonville agreement. Like the falling dominoes, once a start is made the whole line will be pulled down. No State or district can operate half union and half nonunion.

"In view of this state of affairs it is possible that Lewis will stake all by calling out the entire membership of his organization. This move would bring widespread newspaper publicity and the hope would be that this publicity would bring interference from the White House. It would be a desperate throw of the dice, with the future of the country's greatest labor organization hanging in the balance. The record of John Lewis shows him to possess a temperament that might inspire just such a foolhardy decision. With every indication of a noninterference policy by President Coolidge, a long drawn out contest could easily develop. Under the circumstances, with coal prices around bottom quotations for the year, a little extra surplus stock looks like a good investment. The writer did not start out with the idea of writing a 'buy now' editorial, but as the labor situation is closely analyzed, wisdom dictates the accumulation of additional fuel reserves at this time."

Coal Mining Review, in commenting upon the indifference of the American people to the appeals of the leader of the miners' union for justification of their so-called "rights," editorially says:

"If there ever was an doubt whether the American people understand the cause for the anthracite miners' strike, that doubt vanished since the strike has taken place. The indifference of the American people to the appeals of the leaders of the miners for public justification of the strike is the best proof that the American people not only understand the cause but the real issue involved in the strike.

"The people understand that, if the demands of the mine workers' leaders are conceded, it will mean higher cost of coal to the consumers, regardless of whether the consumers are wage earners, farmers, business men, professional men, or whether it is transportation lines, industrial plants, or utility plants. It explains why no enthusiasm can be aroused in support of the anthracite miners' strike.

New Orleans Times-Picayune

Welcome Home

Detroit News

A Pile of Boards Is Not a House

St. Louis Globe Democrat

No Formal Welcome Necessary

© Kansas City Star

Worse Than Useless

"In addition to higher cost of coal to the consumers, there is involved in the anthracite strike, the question of whether the owners of the mines may manage the mines, or whether the mines shall be managed in accordance with the dictates of the leaders of the United Mine Workers. The right of the anthracite mine workers to be organized and hold membership in a labor union is not an issue, but anthracite operators are told they should collect the monthly dues and assessments from the anthracite mine workers and pay the amount so collected to the local unions."

The Wall Street Journal, in discussing the check-off demand of the anthracite miners, believes that the statement made by the United Mine Workers is purely a disguise of the real purposes of the check-off and clarifies its meaning in the following editorial:

"Just why President Lewis, of the United Mine Workers, should have thought it worth while to broadcast support of his demand for the 'check-off' by the mayors of cities in the anthracite field becomes apparent only on a close examination of their definition of it. It is not surprising, nor even significant, that holders of elective offices sympathize with organized labor, where the organization is strong. But the statements of the mayors give Mr. Lewis the opportunity to get into the newspapers a definition of the 'check-off,' the union's device for deducting its dues and fines from the wage envelope, which purports to come from a disinterested source.

"To say that the 'check-off,' which appears as one of the leading demands of the miners' organization upon the anthracite operators, is the same thing as the deduction from wages of house rent, store bills and other items owing by the miners to their employers is sheer misrepresentation. The latter is a bookkeeping process, exactly similar to that of merchants who, having charge items against one another, strike a balance to be settled in cash. The former is the device of the United Mine Workers to force the operators into express recognition of the closed shop.

"Automatic deduction of union dues and fines from the wages before the wages are paid is demanded by the union and refused by the operators for precisely the same reason, namely, its expected and intended effect in strengthening the union. It is relied upon by the union to enable it to collect some dues and fines which it obtains only with difficulty and delay or not at all. The operators have, at least tacitly, admitted the basis of their opposition. Why should Mr. Lewis not frankly admit that he wants the operators compelled to serve as the whips of union discipline?

"Adoption of the check-off could have no appreciable effect upon the proportion between union and non-union labor in the anthracite field, since the Pennsylvania miner's certificate law in practice already enforces the closed shop there. It would, however, render the individual miners practically helpless to resist whatever levies the union officials chose to make upon them, even to the extent of raising a huge war-chest for use in the bituminous fields. It is the last link required to bind up a tight and largely responsible labor monopoly in the anthracite mines.

"If that is what Mr. Lewis really wants, is it too much to ask that he say so? Candid debate of the check-off issues on its merits is the right of both parties. But Mr. Lewis prefers to say, 'The check-off is merely a matter of business convenience—like a typewriter."

Commenting upon an Associated Press news dispatch from Urbana, Ill., at the time of the Illinois Federation of Labor Convention there, the *Manufacturers Record* has the following to say:

"This from an Associated Press news dispatch from Urbana, Ill.:

"'Lawbreaking is part of the duty of a labor unionist sometimes,' J. P. Frye, President of the Ohio State Federation of Labor, told the Illinois Federation of Labor convention today.

"'Just as disobedience to tyrants was obedience to God,' he said, 'so disobedience to injunctions, in some cases, is obedience to the Constitution. I believe in law, but I also believe in human liberty.'

"Yet organized labor leaders and sympathizers, including a surservient press, brazenly and blatantly assert that organized

DOGGONE IT, FOLKS! - I CAN'T BE TIED TO YOUR APRON STRINGS FOREVER - I GOTTA HAVE FREEDOM
GOSH! - I'M GROWN UP NOW, AN' IT'S TIME I WAS STRIKIN' OUT FOR MYSELF - YOU FOLKS IS HAMSTRINGIN' MY PROGRESS
AIR SERVICE
ARMY
NAVY

Wallace Press-Times

Comes a Time In the Lives of All Parents

Washington Star

The Old Star's Sad Soliloquy

labor is patriotic and loyal to the United States Republic and its Government. Also, well meaning but deluded persons deny that communism and the spirit of communism are rampant in the land, tolerated by Federal, state and municipal authorities who are sworn to suppress treason."

Speaking before the National Board of Jurisdictional Awards, the Honorable James J. Davis, Secretary of Labor, emphasized the necessity for the elimination of strikes and the placing of the relations of worker and employer upon a more sound basis, saying:

"I don't know of anything that has done more to destroy the chances of organized labor to deal with large organized industrial interests than these civil wars among the unions. Organized labor has withstood destructive assaults, within and without its own ranks. Here and there people are seeking to break the trade union movement in America, but so long as the trade union movement stands true to its principles and deserves the support of its membership and the public, it will get that support. But, like other movements in this or any other country, organized labor can commit suicide through internal dissension.

"In all fairness the owner employer is entitled to labor's service even though the crafts have a difference among themselves. Our agreements call for unbroken work. If the crafts can't agree, then the matter should go to the Board of Awards in which all are fairly represented. While the difference is being settled, work should go on. And when the board has decided the question, the decision should be accepted. The resulting chaos if we don't set up and abide by this machinery is plain to all.

"After all, the American worker is a business man. We have got to rely on his business sense to refer to a board all matters in dispute. We must appeal to his business sense to abide by its decisions when handed down. And we appeal to his business sense, his sense of profit and loss, to stay on the job and finish the job until his difference is ended."

NON-METALLICS IN NEVADA

(*Continued from page* 540)

tomaceous earth. Many large and pure deposits occur near railroads. It has been mined to some extent in 7 countries out of the 17 counties in the state. At present it is being produced in the Carlin district, Esmeralda County and in Washoe County.

Silica in the form of tripoli is being mined and shipped from the Cuprite district in Esmeralda County. Shipment of this material is increasing rapidly. Deposits of glass sand occur about four miles from Carson City.

Oil Shale and Hydro-Carbons

While no petroleum in commercial quantities has as yet been found in Nevada, the state does have very large deposits of oil shale which represents a very large potential oil reserve. These shales are at present being developed and Nevada has at present the only commercial oil shale plant in the United States. The oil shales are for the most part located in the vicinity of Elko and cover a wide section of the country in that vicinity, and at the present time they are practically untouched.

The Catlin Oil Shale Company has been experimenting for several years to find a successful process for extraction of oil from the shales. After trying many different kinds of retorts they have succeeded in finding a process which they are operating on a commercial scale. The company is in a position to market shale oil, waxes and ammonium sulphate. Some of the preliminary tests on the shale oil indicate that it is going to be the source of very good lubricating oil as well as other grades of oil, but the results with the lubricating oil are especially favorable.

South of Palisade, which lies about at the border of the oil shales, there has been found over an area of several square miles deposits of asphaltite of the variety known as impsonite. Practically no work has been done on the deposits, but at some future time they may prove of commercial value.

Nevada does not have any commercial coal deposits; however, there are several places in the western part of the state where beds of lignite and sub-bituminous are found. One company in the southwestern part of the state has done considerable work on a bed of sub-bituminous coal and is still continuing this work. To date, the high ash content of the material has prevented its commercial use. Research may indicate a method of eliminating the ash or utilizing of the coal which will add another industry to the state.

Sulphur

For many years Nevada has been a small producer of sulphur, and even with the large deposits of the southern states as competitors, has been able to continue production. Sulphur is found in widely scattered locations. The chief production at present coming from the northwestern part of the state from the camp of Sulphur on the Western Pacific Railroad. Other promising deposits occur in Esmeralda and Mineral Counties, while smaller deposits occur in many other places.

In addition to the resources mentioned, Nevada has within its boundaries deposits of magnesite, phosphate rock, limestone, chalcedony, andalusite, fluorite, monazite, mica, nitrates, radioactive minerals and strontium minerals.

Some of these, such as fluorite and mica are being produced on a small scale. Others are not produced at the present time due to present economic conditions. However, with improved methods of handling and increased demand they will become valuable mineral products of the state.

In the past attention has been drawn to Nevada's metal mines, but in the future attention will be directed to its possibilities in the way of its vast store of non-metallics, and in time its production of these minerals will probably far exceed its metal production. With attention drawn to these minerals new deposits will be found. This fact has been emphatically shown recently by the discovery of the large borax deposits in Clark County.

PRODUCTION AND USE OF ROCK DUST

(*Continued from page* 553)

satisfy the humane conscience of the age to adopt a proven safety measure in such a lax manner that it merely becomes a trap in which life or limb may be destroyed. With the adoption of every practicable safety measure known to the art of coal mining the winning of coal will still be a most dangerous occupation, and a particularly venturesome investment. Therefore, rock-dusting should be intensely studied by every coal mine executive until he has convinced himself that it is the measure to adopt for his particular operation to insure safety of the investment in life and capital intrusted to his care; or it should be left alone entirely and his energies devoted to the enforcement of other safety measures in which he has faith. But do not remain in doubt as to the value of any safety measure or alleged safety measure! As the Chief Magistrate of this Nation recently said: "Doubters do not achieve, skeptics do not contribute, cynics do not create. Faith is the great motive power, and no man realizes his full possibilities unless he has the deep conviction that life is eternally important, and that his work, well done, is a part of an unending plan."

And if we are to lessen the terrible toll of human life annually sacrificed on the altar of the Nation's fuel supply it surely is "eternally important" that we approach with unbiased minds every proposed measure of safety that promises to render coal mining less dangerous. Surely, it must be part of "the unending plan" to reduce the terrible hazard now involved in winning that basic material of our civilization—coal.

STANDARDIZED MINE VENTILATION EQUIPMENT

By O. K. DYER*

NOT least among those who benefit by the standardization of mining equipment is the manufacturer of ventilating fans. When the mine operators standardize on any given capacity it enables the manufacturers to select or design a fan to do the work and to put them through in quantities, thereby effecting a great saving in the manufacturing cost. It also means that shipment can be made within much less time. As an illustration in the metal mining field a certain capacity fan has been selected and it required a somewhat special fan to meet these requirements. However, there was a marked demand for one of this particular capacity and pressure, and as a result the fan manufacturers have developed a fan to do the work, which enables them to use a standard motor, and the outfits are now carried in stock, while if there had been no standardization the price would have been at least 50 percent higher, and it would require weeks in which to ship.

The simplification of methods which will result from this movement will make it easier to understand the requirements of each installation and afford the manufacturer a better opportunity to furnish units which will meet these requirements. The problem of mine ventilation will be simplified from the two main points of view; the purchaser in ordering ventilating equipment will know what information is required, and need not present a detailed study of the local conditions, and on the other hand, the engineer estimating the equipment to be supplied will have been previously informed as to what particulars of construction he can safely take for granted. This better understanding will mean a saving in time and money for both the purchaser and manufacturer.

The National Association of Fan Manufacturers recently took a step in this direction, unanimously adopting a uniform method for designating the hand and discharge of fans, and a code for testing all types of centrifugal and propeller fans.

*Buffalo Forge Co.

THE AIR MAIL

MEANS of speedy communication are vital to the business world, and the recent installation of Air Mail Service is the most useful and important measure of postal improvement since the adoption of the railway postal car system in the sixties.

The effect of the new Air Mail routes upon the postal service of the country as a whole should therefore be clearly understood by the business world.

Transmission of mails by air is effected in less than one-half the time required by train. Air Mail letters dispatched from New York about 9 p. m. are delivered at their address in Chicago by first carrier delivery next morning; or if forwarded from Chicago by train to other points, will move by the first morning train instead of by a late evening train. The delivery of such letters in postal territory served from Chicago will thus be expedited by at least twelve hours, and often much more.

Thus, in a very wide zone on either side of the transcontinental Air Mail route, letters destined to any point within that zone may be expedited in delivery by several hours.

In many business transactions, time is of much importance. The Air Mail Service is of great value in all such cases. It supplies a very desirable facility, especially beneficial to business men, and should be used by them for letters, the speediest possible delivery of which is desired. In the case of such letters, the extra postage charge is negligible.

HANDLING OF MATERIALS IN UNDERGROUND MINING

(*Continued from page* 554)

influence on the method used. It was only about 20 years ago that mule haulage became general. In Bisbee, for example, mules were first used for underground haulage in 1905 or 1906, when the Holbrook shaft caved, and it became necessary to tram the ore from that division to the Czar and Spray shafts.

I. H. Barkdoll says regarding this: "After tramming by hand for a few weeks, I induced Mr. Clawson, then Superintendent, to get me some mules; we purchased three mules, and from that time they were used exclusively for long trams until they were replaced by electric motors." Electric haulage was introduced soon after this and quickly displaced the mule, and today the mule has practically disappeared from the larger mines.

With electric haulage came the development of skip hoisting, the need for storage pockets underground, the development of equipment for loading the skips and automatic dumping and disposal at the surface. This has greatly changed practice in the location of shafts, the distance between mine levels, the planning of development and even in mining methods. The development of the low-grade mines with the need for large-scale production at low cost, brought about rapid development in the methods of transportation and hoisting of ore. The equipment for underground haulage and hoisting at the Inspiration Mine, as described elsewhere in this issue, is perhaps the highest development yet reached for the production of a large tonnage from an underground mine.

The transportation and distribution of underground supplies has not, in general, been given the same study that has been applied to the handling of ore and waste. And at many mines there is much room for improvement in the method of distribution and the checking of the supplies. The method of checking and distributing supplies at the Pilares Mine of the Moctezuma Copper Company has recently been described by E. E. Leland, Mine Superintendent. At this mine the concentration and rather systematic distribution of the ore bodies within a small area makes possible exceptional efficiency and system in the distribution of supplies. This problem has been carefully studied and well worked out at the Miami Mine. Here the use of Otis elevators with cages large enough to accommodate loaded timber trucks is an innovation. This is described elsewhere in this issue.

What of the future? It is certain that new mechanical equipment will be devised and new methods introduced. Will the greatest improvement of the next few years be in the drilling and breaking of ground, in loading, in ore and waste transportation, or in hoisting? It would seem that the greatest opportunity for progress in the immediate future is in loading and in the transportation of ore and waste. It is probable that mechanical loaders, already effective under certain conditions, will be developed to such an extent that they may effectively displace hand-shoveling. Hand-tramming for distances of 500 or 600 feet is still common practice in most of our large mines. In this there is room for improvement by the use of storage battery locomotives or some other device for gathering the loaded cars to the place where motor trains are made up. In a recent article Arthur B. Parsons asks the question, "Has the continuous conveyor a place in metal mines?" He shows that it has attained remarkable success in coal mining, and discusses the obvious operating difficulties in its application in metal mining and also conditions under which its use might be possible. The possible use of the continuous conveyor for underground transportation of ore in metal mines in the near future would seem to be limited to the case of a large tonnage of ore in a compact ore body.

The above are merely suggestions of a few lines along which improvements and changes may come. The future doubtless will bring the development of equipment and methods not now dreamed of.

REVOLVING SCREENS FOR MINE USE

OF the four main classes of screens the class that has received most attention is called a revolving or roller screen at coal tipples and a trommel or drum screen in ore-dressing plants. Such screens are common equipment at ore mills where perfect screening is more important than speed, and where wet screening is usual for the sizes ranging from 15 to 2 mm. Revolving screens are so likely to break friable coal, however, that they are not favored for coal sizing and are not being installed in new plants. For coal sizing they usually take a dry feed, unless used in a washery. A revolving screen in its simplest form is a cylindrical frame with an envelope of wire-screen cloth, perforated plate, or even bars, and with its longitudinal axis set at a slight angle. The screen receives material at the upper end, discharging the oversize at the lower end; it revolves slowly, and carries the particles of material up the rising side until gravity overcomes both their friction against the screening surface and any centrifugal force given them by rotation. Each particle rolls or slides down until it comes to rest and then is carried up the slope again. Detailed descriptions of various types of revolving screens are given in Bulletin 234, recently issued by the Bureau of Mines.

TYPES OF FLOTATION REAGENTS

THE reagents employed in flotation work are of two types, one being known as "flotation controlling" agents, and the other as "flotation" agents, states the Bureau of Mines in Serial 2700, just issued. "Flotation controlling" agents are those substances or chemicals of the inorganic class, that are added to the ground ore-water pulp to add vigor to the floatability of a particular mineral or to decrease the floatability of a particular mineral.

"Flotation" agents are those substances, invariably of organic nature, that cover the mineral particles with a film that permits them to be caught by the bubbles injected into the pulp. Another property of such substance is to lower the surface tension of the water, thus permitting the formation of small bubbles and a froth.

Generally speaking, the controlling agents should be and are added to the pulp at some point in the mill prior to the addition of the oils. Sometimes chemicals, such as lime, are added to the ore as it is dumped into the mill feed bins, but, as a rule, the controlling agents are added to the fine grinding ball mills. The oils, if they are heavy and difficult to incorporate, may be added with the controlling agents to the same grinding mill. This would not seem to be good practice, but it is often done. Again, in many plants the reagents are mixed with the ore pulp in separate agitators.

The time of reaction required for controlling agents to import the desired change in surface properties to the respective minerals present depends upon the ore being treated and the controlling agent found suitable for its treatment. With most reagents and most products a "conditioning" period of one to five minutes generally is sufficient. In the treatment of a collective float concentrate of two minerals, A and B, to be separated into A and B concentrates, where, say, A is to be floated and B is to be suppressed; a conditioning period of several minutes to a half hour may be necessary.

Where sodium or potassium xanthate is the reagent, it is fed direct into the first cell of the flotation machine, and a conditioning period of any consequence does not seem to be required.

LEASING WORK REORGANIZED

REORGANIZATION of the oil and gas-leasing work and field administration of the public oil lands under control of the Geological Survey has been announced by the Interior Department.

Establishment of three field divisions under the jurisdiction of district supervisors who are engineers in charge with full authority and responsibility to conduct operations and represent the Government comprises the salient feature of the reorganization. The divisions include the Rocky Mountain district, with headquarters at Casper, Wyo.; the Pacific district with headquarters at Taft, Calif., located in the heart of the California oil fields; and the Mid-continent district, with headquarters at Muskogee, Okla.

Centralization of authority in the engineers in charge of these districts resulted from the constant development of operating problems, necessitating immediate decision and requiring a high degree of skill in oil-field operations. Up to the time of the reorganization it has been the custom to refer all questions of administration to the Washington headquarters of the Geological Survey before final action was taken. Under the new plans the engineers in charge will act on their initiative and authority.

The engineers placed in charge of the various districts include R. C. Patterson, at Taft, Calif.; J. W. Steele, at Casper, Wyo.; and H. J. Lowe, at Muskogee, Okla. Under the new plan of decentralizing responsibility in the field, the vacancy created by the resignation of Fred B. Tough, formerly having supervision over oil and gas-leasing activities in the Geological Survey, will not be filled.

A feature of the reorganization will be the periodical detail to the Washington office and of the supervisors and deputy supervisors in order to keep them in close touch with department policy and duly acquaint the chief of the Conservation Branch and the Director of the Geological Survey with field problems.

TRANSPORTATION AT MAGMA

(*Continued from page* 563)

In attempting to make a comparison of the transportation system in the Magma mine with that of a large porphyry mine of the Southwest, several major points of difference stand out, among which may be mentioned equipment, both as to size and quantity.

As stated above, the ore is handled in 2-ton cars, 10 cars to a train, a load of 20 tons. The total production of the Magma mine is handled with ease in two 8-hour shifts by one train. Some of the large mines have trains of ten cars or more, each car holding 10 to 25 tons, several trains operating each shift for two or three successive shifts.

Another point of difference is the track layout. Curves as short as 25-foot radius are used successfully in the Magma mine, while in the large mines, with track of broader gauge, curves up to 150-foot radius are not uncommon.

Storage raises and shaft pockets are smaller in the small mine.

The life of the haulage level is another important difference, lasting in the Magma three or four years, and in the larger mines perhaps 10 to 15 years, or in some cases perhaps for the life of the mine.

Summed up it might be said that in the case of the small mine one unit is used, while in the large mines several units of the same size, or larger, are used.

Ransome, U. S. Geol. Survey

Big Jim and Oatman Mines, Oatman District, Ariz.

TRANSPORTATION AND DISTRIBUTION AT MIAMI COPPER CO.

(*Continued from page* 558)

drawing and tramming the ore. It is therefore unnecessary to have a tool man in the central tool room on the 3 p. m. and 11 p. m. shifts. The tools on these two shifts are issued by the powderman or a nipper. One day the toolroom man, in addition to issuing supplies, repairs broken air and water hoses for the entire mine.

Before the central tool room was built, smaller tool rooms were located at different points on the 620 level—one tool room serving each boss's territory. Each boss was responsible for seeing that his men returned their tools to the tool room at the end of the shift, but with three shifts using the same tool room the system did not work well. "The other shift" never took care of the tools. The system of giving each boss on each shift a tool room was also tried but was not very economical, as three times as many tools were needed in the mine as were in use at any one time.

On the sublevels above the 570 the drifts are all on contract and each contractor keeps his tools in his own drift. On the 720 haulage level all the work except tramming the ore is done on day shift under one boss, who has a small tool room.

In the foregoing discussion of the transportation and distribution of underground supplies at the Miami mine the attempt has been made to emphasize the following points: The organization of the supply department under one head; the transportation features, including the track system and elevators; the 620 level supply drift system and the central tool room. The organization of the supply department under one head enables the mine superintendent to delegate the responsibility for the efficient operation of the supply system to one man. The transportation equipment and the 620 level supply drift system facilitate efficient handling, and the use of a central tool room prevents loss and waste of material.

The authors of this paper wish to thank Mr. J. H. Hensley, Jr., the mine superintendent, and Mr. Louis Ware, the assistant mine superintendent, for their assistance and cooperation. The maps and charts are the contribution of the engineering department.

UNDERGROUND MINING OF LIMESTONE

LIMESTONE, which finds industrial use in the United States to the extent of approximately 120,000,000 tons per year, is obtained chiefly from open-pit quarries, but with gradual depletion of surface deposits, more and more operators are being forced to use underground methods. As quarrymen are not necessarily familiar with underground mining, a complete study of the mining of limestone in this manner has been made by engineers of the Bureau of Mines, with the object of determining the methods in use, ascertaining what constitutes good and bad practice, and suggesting improvements in methods when practicable. As a result, complete data were obtained, with the hearty cooperation of the industry, on 52 of the 64 mines known to have underground workings. The information obtained by the Bureau of Mines will be embodied in publications to be issued within the comparatively near future.

MANGANIFEROUS ORE

(*Continued from page* 529)

lent increase in sulphur-content of ores and coke makes the use of more manganese in the furnace mixture the more desirable if not compulsory.

In the last few years nearly all the so-called important makers of steel have purchased regularly a supply of manganiferous iron ore, and now the largest consumer—the United States Steel Corporation—has inaugurated the practice and is using Cuyuna ores. It seems inevitable that the consumption will be increased in a few years to meet the full requirement of all existing plants, and thereafter increase further as the number of furnaces or capacity grows because of the enlarging demands for steel by this rapidly growing nation. Manganiferous ores are now an essential ingredient in the open-hearth furnace mixtures and will be sought regularly. The location of the industrial area served eliminates competition of ores from foreign sources; and that makes the mining operations safer to the investor.

LEGISLATIVE FORECAST

(*Continued from page* 532)

duction of war minerals during the war.

Silver Purchase

Silver men of the West will be benefited if Congress passes a bill for the Government purchase of 14,000,000 ounces of silver at $1 per ounce to complete purchases under the Pittman act. This bill was passed by the Senate in the last Congress but was not reached by the House before Congress closed last March. Advocates of this legislation will reintroduce the measure and push for its passage this session.

Regulation of the issuance of mining securities will also be sought. A bill along this line was considered by the House in the last Congress, but after it was amended in a manner beyond the scope intended by its author, Representative Denison of Illinois, the bill was allowed to die on the calendar.

An effort to continue the Senate Gold and Silver Commission may also be made. This commission conducted investigations as to mining costs, mine prospecting and development, and currency and exchange matters, during the last two years. The Senate at the last session, however, declined to continue the commission for two more years after March 4, 1925.

Legislation amending the mining laws concerning prospecting for and development of minerals may follow as the result of hearings conducted since March by the Senate Public Lands Committee. This committee has heard mining men in the Western States on the administration of the present mining law. Considerable dissatisfaction with the present restrictions under the law have been expressed by some members of the committee as well as by mining men, and may result in the committee recommending changes in the law to permit development of mineral deposits under more reasonable conditions.

Power development is expected to be brought up in Congress when the Muscle Shoals nitrate and power project in Alabama is again considered. This subject was considered during the last Congress, but no satisfactory bill could be drawn and the legislation failed. Since Congress adjourned last March a commission appointed by the President has been considering the matter, and is expected to recommend a plan of operation for the project for action by Congress.

Transportation legislation both by rail and water is expected to be brought up. Strong effort will be made to repeal the Hoch-Smith Law passed in the last session, which authorized a general revision of the entire freight rate structure. In water transportation the Shipping Board will enter the spotlight because of its tilts with the President. H. G. Dalton, of the iron ore and coal firm of Pickands-Mather of Cleveland, has been investigating the situation for the President. The row may result in Congress abolishing the Shipping Board and transferring its duties to the Department of Commerce.

Mining interests will be affected by proposed legislation forbidding pollution of streams. The War Department has been investigating this subject for more than a year under a recent Act of Congress and will report the extent of pollution and measures to check it. This investigation has covered the discharge of acid mine waters as well as wastes from industrial plants. Congress has already forbidden the discharge of oil in coastal navigable streams, and bills are expected to be introduced to forbid pollution of all streams by any substance.

NEWS OF THE MINING FIELD

A Résumé Of The Activities Of The Mining Industry And Items Of Interest In The Field

Merger of Nevada and Ray Consolidated Copper Companies

A merger of a number of southwestern copper companies has practically been completed, whereby the Nevada Consolidated acquires control of the Ray Consolidated Copper Company, including the Chino, which was recently acquired by the Ray. All that the deal now needs is the ratification of the stockholders, and there is little doubt but that their approval will be given at special meetings which have been called for November 11 for this purpose.

The proposed consolidation calls for the issuance of one share of Nevada capital stock in exchange for each share of Ray Consolidated stock outstanding.

The purpose of the consolidated is to bring about unification of production and curtailment of operating expenses. All three companies hold an important position in the copper producing industry. Their combined output last year was in excess of 200,000,000 pounds, of which Nevada Consolidated produced about 70,000,000 pounds, Chino, which is owned by Ray, the same amount, and Ray Consolidated about 60,000,000.

Following the announcement of the Nevada-Ray merger, a report was current in New York that a merger of three additional companies is being planned, to include Kennecott Copper, Ray Copper and Utah Consolidated Copper companies. This would bring under one management concerns whose aggregate production is about 800,000,000 pounds a year. It is said that the Kennecott Companw now owns about 90 percent of the capital stock of Utah, while Utah owns more than half of Nevada stock. As Ray already owns control of Chino, the Nevada offer, if accepted by Ray stockholders, will bring the five concerns together.

Arizona Senator Urges Tariff of at Least Six Cents on Copper

The American copper industry is menaced by South American and African competition, according to Senator Cameron of Arizona. He declared that a tariff of at least 6 cents a pound should be placed upon copper to protect domestic industry against low production costs including cheap labor among our competitors.

While the United States is consuming the greatest amount of copper in its history, he stated, copper producing districts of his state are running on a 60 percent production basis and next year will decrease to 50 percent with a falling off each year until some relief is obtained.

Northwest Mining Convention November 29 to December 5 at Spokane

The Northwest Mining Association will hold its thirtieth annual convention in Spokane, November 29 to December 5. Frank C. Bailey, secretary of the association, promises that it will be the biggest and best ever held.

Sessions will open Monday, November 30, in the Chamber of Commerce Building, and will be held daily.

New officers of the association will be installed during the convention. The new president, just elected by the trustees, is Arthur L. Hooper, with mining interests in Washington and Idaho. M. J. Sweeny, of the Boyles Brothers diamond drilling concern, is vice-president, and R. K. Neill, who brought the famous Premier mine on the Portland Canal into the big dividend class, is second vice-president.

Sessions will be devoted to each Northwest and Coast mining state of province, with state chairmen as follows: Idaho, Dean Francis A. Thomson of the School of Mines, University of Idaho; Montana, Senator C. S. Muffly, president of the Montana Mining Association; British Columbia, R. G. Langley, resident engineer for mineral district No. 3, Revelstoke, appointed by William Sloan, Minister of Mines; Oregon, H. E. Hendryx, former editor of the Baker Herald; Washington, President Arthur L. Hooper of the Northwest Mining Association; California, Lloyd L. Root, state mineralogist; Alaska, Maurice D. Leehey, of Seattle.

Ore exhibits from all parts of the Pacific Northwest will be on display, a number of districts having already asked for additional space.

Tri-State Zinc and Lead Ore Producers' Annual Meeting

The Tri-State Zinc and Lead Ore Producers' Association held its annual meeting on October 18 at Pitcher, Okla.

J. F. Robinson, of Miami, was reelected president; C. F. Dike, of Joplin, was elected first vice-president; and S. D. Davis, second vice-president. George Pearson was reelected treasurer and J. D. Conover, secretary.

The executive committee for the ensuing year will be composed of President Robinson, Vice-President Dike, F. C. Wallower, T. F. Coyne and Frank Childress.

The question of advertising zinc received considerable attention at the meeting. The association has approximately $32,000 accumulated towards the $100,000 advertising fund which was voted at the 1924 annual meeting of the American Zinc Institute. Other mining interests, and business interests of the district have raised the same amount.

The opinion of the members who discussed the problem was that the question of advertising zinc was not a lost possibility and if the smelters did finally agree to raise their $50,000 of the proposed fund, the association would have its money available.

American Zinc Institute Directors to Meet

The fall directors' meeting of the American Zinc Institute will be held at St. Louis on November 6. Prior to this on the same day there will be a meeting of the committee of six (three zinc ore producers and three zinc smelters) who were appointed to consider the means for attaining a closer cooperation between these two branches of the industry.

Supreme Court Upholds Smelter Decision

The United States Supreme Court has refused to review the decision of the circuit court of appeals in the case of George C. Carson against the American Smelting & Refining Company, in which it was sought to determine whether copper smelting companies were infringing patent rights of Carson in reverbatory furnaces. The question was raised on appeal by the American Smelting & Refining Company, which lost the decision in the circuit court last February.

In addition to the suit against A. S. & R., Carson started litigation against many other large copper companies.

A way is said to have been opened for action for royalties, estimated anywhere between $2,000,000 and $20,000,-

000, to be paid Carson by copper smelting companies. The American Smelting & Refining Company is no longer using the Carson method of feeding furnaces, having developed more advantageous methods that do not infringe the Carson patents. It is therefore believed that the actual damages allowed Carson for the infringement will be comparatively small as they can amount only to the saving resulting from the use of the Carson method compared with other available methods of feeding.

Annual Colorado Mining Meeting to Be Held in Denver

Colorado's mining industry and its builders will assemble for a reunion in Denver on January 25, 26 and 27 on the occasion of the joint meeting of the Colorado Metal Mining Association, the Colorado Chapter of the American Mining Congress and the Colorado Mining Fund. An outstanding feature of the meeting will be the annual "sowbelly dinner" on the night of January 25.

Will Make Study of Deep Mining In Cripple Creek District

A study of the possibilities for deep mining in the Cripple Creek district of Colorado, which already has produced $350,000,000 from levels above 1,000 feet, is to be undertaken by the Federal Government in cooperation with the Colorado Metal Mining Association.

G. F. Loughlin, chief of the metaliferous geologists of the Geological Survey, has gone to Cripple Creek to begin his work, which probably will require several months.

Loughlin will begin his study of the deep mining possibilities of the district by examining ores found at the 3,000-foot level of the Portland mine, and the 2,000-foot level of the Cresson mine.

Should Loughlin, on the completion of his examination, recommend deep development throughout the Cripple Creek district, the famous old camp is expected to undergo new development, which will result in the expenditure of huge sums of money in quest of deep ore bodies.

Charles W. Henderson, Chief Mineral Geographer for the Survey in Denver, has recommended that a new study be made of conditions in the Bonanza district of Saguache County, the Taylor Park section of Gunnison County and the western extension of the Silver Plume districts in Clear Creek and Summit Counties.

The annual meeting of the California Metal and Mineral Producers Association was held in San Francisco, October 28, for the purpose of electing three directors to serve for a period of two years, and for the consideration and transaction of business.

New Oil and Gas Survey Sought in California

A new oil and gas survey of Northern and Central California is to be sought by the newly formed oil and gas prospecting divisions of the Sacramento mining department. Early in November a committee will call upon State Mineralogist Lloyd L. Root to request a resurvey. The existing petroleum map of the state mining bureau shows San Joaquin, Sacramento, Placer, and Sutter counties and portions of Yolo and Colusa counties as "improbable" oil areas, whereas exceptional oil and gas structures have been found in these districts recently and ten companies are sinking wells. The northern oil pioneers claim this map prevents them interesting southern oil men in testing out the northern field.

The Sacramento department is also working hard to secure the erection of a permanent counties mineral exhibit building at the State Fair grounds in Sacramento.

Relief For California's Mining Industry

That the mineral industry of California, which exceeded agriculture last year in value of production by $7,000,000, is urgently in need of relief from burdensome federal taxation, removal of the bond requirement for prospecting grazing lands, rigid enforcement of the highgrading law, revision of the present interpretation of blue sky laws, new mineral surveys of California, and state recognition and assistance on a par with agriculture through the creation of a state mining department, was brought out at the recent regional conference at Grass Valley.

This meeting was the first of six to be held under the auspices of the mineral division of the California Development Association, in cooperation with the Department of Mines and Mining of the Sacramento Chamber of Commerce. Meetings have been held since at Stockton, Redding and Sacramento. Others are scheduled for San Diego, Bakersfield and Los Angeles. Out of these meetings will be formulated a state-wide program for the betterment of the industry.

$1,000,000 Donation to Central Copper Company

One of the most unusual ceremonies connected with any industrial organization was that held at the annual stockholders meeting of the Central Copper Company at Dos Cabezas, Ariz., October 5, 1925, when $1,000,000 in notes and interest coupons, given as an outright and unconditional donation to the company by the president, N. McCauley, were burned.

This is probably the first instance in industrial history where a donation of any such magnitude has been made to a company treasury and the company entirely relieved of a million dollars of indebtedness to its president.

The notes and interest coupons represented were some of those personally owned by Mr. McCauley. The ceremony of destroying these obligations was held in the presence of many of the directors and stockholders of the company.

In his message making the gift Mr. McCauley stated that it was done to show his appreciation of the splendid cooperation accorded him by the stockholders of the company and to assist in reaching production and dividends at the earliest possible date.

Missouri Mining and Metallurgical Association Elects Officers

At a meeting of the Missouri Mining and Metallurgical Association of the School of Mines and Metallurgy, held at Rolla, October 21, the following officers were elected: E. H. Griswold, president; Prof. H. R. Hanley, vice-president; Samuel E. Craig, secretary; and James Crawford, treasurer.

The program for the year is now being planned, and will be both educational and entertaining.

Nevada Supreme Court to Hear Bullion Tax Case

The Supreme Court of Nevada has set the case of the State vs. the Tonopah Extension Mining Company for argument November 30. This was a test case brought up as a "friendly suit" to determine what constitutes a proper charge in computing net proceeds for bullion tax. The case was tried in Nye County and the judgment of the district court sustained the contention of the State.

Two of the principal items over which the State tax commission and the mine operators disagree are depreciation of equipment and the cost of development work. The Tonopah Extension and other Tonopah companies for several years have paid the net proceeds tax as claimed by the tax commission, protesting the difference, but other corporations have paid on the basis of their own calculations. If the State should win, these corporations will have to pay several hundred thousand dollars in back taxes.

Bingham Mines Company Acquires Control of Montana-Bingham

Announcement has been made by the Bingham Mines Company that it has acquired control of the Montana-Bingham Consolidated Mining Company property in the West Mountain mining district,

Salt Lake County, Utah, comprising the Tiewaukee, Eddie and Fortuna groups and the Thrush claim, a total of 277 acres. A large part of this property adjoins the Winamuck and Dixon properties, recently acquired by the same company.

The Bingham Mines Company now owns and controls in Bingham a total of 1,843 acres. It is proposed to carry on extensive development work in the Montana-Bingham property with a view of putting it into the productive stage as early as possible.

Anaconda Will Put All Copper Into Finished Products

In speaking of the improvements and additions to the various plants of the Anaconda Copper Mining Company, Floyd S. Weimer, chemical engineer of the Anaconda Smelter at Great Falls, says that although copper has not attained the level at which it formerly was considered necessary to operat profitably the Butte mines, officials of the company had supreme confidence in the future of the copper industry as well as the zinc industry, and had evolved a plan of operation whereby they can keep the mines running even at present metal prices. He said that the extensions to the plants indicated that the company plans to convert all the ore in the mines in Montana into finished copper product before it leaves the State.

Anaconda Introduces Copper-Asphalt Roofing

The Anaconda Company recently announced that commercial production of a copper covered nonmetallic substance had been accomplished and put to a large industrial use as a roofing material. The roofing is asphalt covered and impregnated with copper.

Many years ago it was discovered that copper could be deposited electrolytically, having fine texture and high tensile strength. Innumerable attempts have been made to transfer this discovery from laboratory to factory. Up to this time they have been unsuccessful when applied on nonmetallic bases.

Columbia Steel Corporation Buys Big Tract

The Columbia Steel Corporation has acquired from the Milner Corporation of Salt Lake City its Milner-Dear-Lerch iron ore holdings at Iron Mountain. The tract consists of 921 acres and geologists report that deposits there contain millions of tons of high grade hematite ore, averaging 58 percent iron. Actual operations will be begun next Spring, it is reported.

Utah Mines Show Big Increase in Dividend Rate

Utah metal mines during the third quarter of the year disbursed dividends to stockholders at the rate of approximately $13,000,000 annually as compared with dividends of $9,000,000 paid during the twelve months of 1924. Improved prices of lead, silver and zinc, as well as copper, will no doubt allow the state's metal mining industry to equal or better the record of the third quarter during the fourth quarter, and make 1925 dividends exceed those of 1924 by a sum ranging from $3,000,000 to $4,000,000.

Colorado Fuel & Iron May Build New Smelter

It is reported that the Colorado Fuel & Iron Company is looking for a site in Wyoming suitable for a smelter. Some time ago it was rumored that a site had been purchased east of Casper, with a view to the development of the enormous deposits of iron ore in the Deer Creek Mountains. However, the person reported to have made the sale would not confirm it, and nothing more has been heard of the transaction. According to the new rumor, the Colorado Fuel & Iron Company is considering Parco, on the Union Pacific, as a possible location for the plant.

Labor Federation Backs Miners After Lewis Makes Charges

Support of the American Federation of Labor was accorded the 150,000 striking miners in the anthracite fields after President Lewis of the United Mine Workers had addressed the delegates at their recent convention at Atlantic City and stirred them to enthusiasm by his recital of conditions in the industry.

Mr. Lewis said the miners would not falter or depart from the policy laid down and he warned the public that it was due for a "rude awakening" if it believed there was an ample supply of coal on hand.

"Hundreds of thousands of homes will be without fuel and will be unable to secure fuel," he said, "until it can be produced at the mines and distributed."

Mr. Lewis also charged that the operators were extorting millions of dollars from the public by selling inferior grades of coal. These charges are more fully outlined in the reply of Samuel D. Warriner, which appears on page 531 of this issue.

Chamber of Commerce Endorses Arbitration Demands of Anthracite Operators

The directors of the United States Chamber of Commerce have approved the following resolution, which was adopted by the Advisory Committee of the Natural Resources Production Department of the Chamber:

"The Committee expresses its hope that the present anthracite strike will be permitted to settle itself along economic lines, without political agitation or governmental intervention.

"The Committee believes that the action of the Governor of Massachusetts has done much to remove the apprehension of the public of a winter coal shortage, by directing attention to the use of substitutes and by developing practical information on how to use these substitutes. * * *

"The Committee approves the demands of the operators that the issues of the present anthracite strike be settled by arbitration; and if suitable opportunity arises during the course of the strike, the officers of the Chamber should strongly support the principle of arbitration to effect a settlement."

Union Demands Loading Machine Scale

Notice has been served on the coal mine operators of Illinois that the miners' union of that State will oppose further installation of new mining devices or new mining systems until labor agreements have been made covering the wage scales to be adopted in connection with the new devices or systems.

The notification was given in the form of a letter from President Frank Farrington, of District 12, of the United Mine Workers of America, from the Springfield headquarters, embodying a motion adopted by the miners' district executive board at a meeting the first week in October. It is said to have been sent to the Central Illinois Coal Operators' Association, the Fifth and Ninth District Coal Operators' Association, and the Illinois Coal Operators' Association.

West Virginia Has Motor Cars for Mine Emergencies

West Virginia can now boast of being the only state in the Union that is equipped with cars of the automobile type to be used as a service car for safety directors to answer calls to mines which have been visited by disaster. The outfit was designed by Chief Robert M. Lambie of the State Department of Mines.

The car is equipped with every modern safety device known and has safety lights on both front and rear of the machine, which can be used as trouble lights should the lights at the mines fail. When it is necessary to have an ambulance car it can be quickly converted into an ambulance that will comfortably take care of three men.

These cars are stationed at Maitland, McDowell County; Matoaka, Mercer

County; Williamson, Mingo County; Logan, Cabell County; Charleston, Kanawha County; Elkins, Wheeling, Fairmont, Morgantown, covering the northern part of the state, and Mt. Hope, for Fayette County.

Illinois Mines Lead in Safety

Illinois now leads all states in the union for safety in coal operations, according to the annual report of the state department of mines and minerals, which reports less than two fatalities for each million tons of coal mined in the year ended June 30. There was a total of 117 fatalities reported.

"The accident percentage in Illinois is extremely low," A. D. Lewis, director of the department said. "Illinois' percentage of fatalities is less than two for a million tons, while the average in all states is approximately four per million tons."

D. Holmes Morton Heads Kanawha Operators

At the twenty-second annual meeting of the Kanawha Coal Operators' Association, held at Charleston, West Virginia, October 15, D. Holmes Morton, General Manager of the American Eagle Collieries Company and the Leevale Coal Company, was elected president to succeed John Laing who, after service of two years, had found it necessary to relinquish the office. E. O. Dana, president of the Campbell Creek Coal Company, was elected vice-president. The new board of directors consists of the following: C. A. Cabell, E. O. Dana, John Laing, F. O. Harris, E. M. Merrill, W. G. Mitchell, D. Holmes Morton, H. L. Warner, and W. M. Wiley.

D. C. Kennedy was reelected secretary and John L. Dickinson was reelected treasurer.

$30,000,000 Coal and Gas Merger in Tennessee

A merger of coal companies involving a sum of approximately $30,000,000 has been announced in the purchase by the Bon Air Coal & Iron Corporation of the properties of the Tennessee Consolidated Coal Company and the Chattanooga Gas & Coke Company.

Other companies which will form the giant merger are the J. J. Gray Foundry, Rockdale, Tenn., already acquired by the Bon Air Company, and the Southern Ferro-Alloys Company, owning plants at Chattanooga and Cleveland, Tenn. The deal for the latter company has not been consummated, but it is expected that its properties will be acquired.

Chemical by-products from the production of coal is said to be one of the activities of the new corporation.

Pittsburgh Coal Mine Resumes

A total of 107 men reported for the first day's work at Midland No. 1 mine of the Pittsburgh Coal Company, at which operations are being resumed under the 1917 scale.

This is the first mine of the company in the Panhandle division to resume operations, the two pioneer mines at Banning being in the Youghiogheny Valley. It is the seventh mine of the company operating on the 1917 scale, including four pits in the Pomeroy district of Ohio. The Midland mine was closed in November, 1923. The company has 37 idle mines in the Pittsburgh district.

Announcement was recently made by the company that it has more men working today under the 1917 scale in the Pittsburgh district than ever before. The number of men working at the Midland mine is also the highest.

Boston & Maine to Rebuild Discharging Terminal

Directors of the Boston & Maine Railroad have voted to appropriate $450,000 for the purpose of rebuilding its discharging terminal on the Mystic River, Boston, at which it discharges all of its own tidewater coal and the bulk of the bituminous shipped from Hampton Roads. It was stated that it would probably be possible to effect a saving of 35 percent annually with the new and modern equipment.

Harrisburg M. & M. Takes Group Insurance

The Harrisburg Mining & Milling Company, engaged in lead and zinc mining at Cardin, Okla., has purchased from the Metropolitan Life Insurance Company a group policy which provides for its employes a total protection of approximately $76,000.

Each employe is insured for $500, which will be increased to $1,000 at the end of six months; and to $1,200 at the end of a year. This protection will be increased to at the yearly rate of $200 until a maximum of $2,000 is attained. The entire cost of the insurance is borne by the company.

Test Nevada Coal Veins

The Western Coal Mines Corporation which owns lignite coal deposits near Coaldale, Esmeralda County, Nevada, has been financed for further development and will install a core drill for exploratory work. H. A. Darms, general manager, proposes to sink several holes from the surface to prospect the veins at greater depth than hitherto reached, and ascertain conditions. Darms has interested several Nevada men in the enterprise and they have provided funds for the work.

Cost of Anthracite Strike

The strike of the anthracite mine workers has cost the industries directly affected about $165,000,000, according to reports tabulated by the New York Times. Of this sum about $78,000,000 represents wages which railroad and coal employes might have earned. In addition, there are losses to merchants in the hard coal region of Pennsylvania, which the reports state can not be accurately estimated.

That America's supplies of gasoline will fail long before the coal mines are exhausted and the nation be compelled to get substitutes from coal for petroleum gasoline, was the prediction made by Dr. A. C. Fieldner, chief chemist of the United States Bureau of Mines, before a session of the American Chemical Society in New York.

Ball Mill Crushing

The latest bulletin issued by the University of Minnesota is entitled, "Ball Mill Crushing in Closed Circuit with Screens," and is by Edward W. Davis. The paper deals especially with the use of screens to close the circuit as they produce a more evenly sized product than does a classifier. The experimental work described in the bulletin demonstrates clearly that closing the circuit with screens results in increased grinding capacities and lower operating costs.

Report Americans Negotiating for Zinc Works in Germany

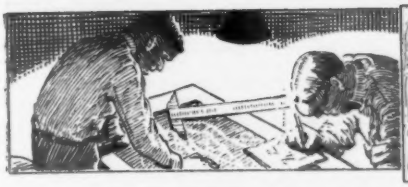
A cable from Berlin to the Wall Street Journal states that the German part of the Giesches Erben zinc works has been sold to the extent of 49 percent of capital participation to the Anaconda Copper Mining Co., and Harriman & Co. It was later stated by Harriman & Company that while negotiations were under way, nothing definite in the matter had been reached.

Tungsten Deposits Reported in Maine

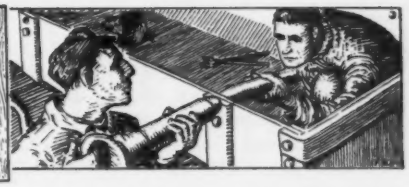
A deposit of tungsten ore is reported to have been discovered near Lewiston, Maine. Claims have been staked off and filed and sufficient backing obtained to insure development, which will begin immediately.

W. R. Alexander, a Montana mining and civil engineer, formerly in the employ of the Central Maine Power Company, is said to have made the discovery.

Several more nonunion bituminous coal mines along the Baltimore & Ohio Railroad have opened recently on the Monongahela division, making a total of 103 operating there. The efforts of the mine union to call out nonunion miners are said to have failed.



WITH THE MANUFACTURERS



New Combination Disconnecting Switch, Fuse, and Choke Coil

One of the new products recently brought out by the Westinghouse Electric and Manufacturing Company is a combination disconnecting switch, fuse, and choke coil, designed to reduce the size and weight of the combined unit as well as the number of insulators required for a given installation. The possibility of trouble through insulator failures is reduced, and a saving in initial and upkeep costs is effected.

Insulator assemblies, such as are standard for other lines of Westinghouse outdoor apparatus, are used with these combinations. These standardized insulator assemblies employ only three bolt circles for the complete line. Two combinations are available, one with underhung and the other with inclined insulators, both of which use the same assemblies for a given voltage rating. The insulators have sanded heads and pinholes which adhere firmly to the cement. All hardware is galvanized and is provided with cupped and ribbed holding surfaces from which the cement cannot slip. The Portland cement, used at both cap and pin, is steam set so that injurious stresses due to temperature changes will be avoided. The combinations are available for all voltages up to and including 110,000 volts.

A leaflet, L-20136, which describes these combinations, has recently been issued by the Westinghouse Company, and can be obtained from the East Pittsburgh, Pa., plant, or from any of the district offices.

New Automatic Welding Equipment

The latest addition to the General Electric automatic arc welding line is equipment especially designed for the construction of range boilers and small tanks. This equipment includes two separate automatic arc welding machines, one for welding longitudinal seams and the other circular seams. Tank sizes accommodated run from 11 to 33 inches in diameter and up to 6 feet in length.

Economy in manufacture is the principal advantage claimed for the automatic arc welding process. Reasons given for this economy are the simplification of the construction process, eliminating punching and riveting, the increase of production over the same period with less help, and the large reduction in defects.

The equipments for both longitudinal and circular seam welding are made up of the same standard units as are used with other automatic arc welding equipment, with the exception of the framework for holding the tanks. This framework is especially adapted to the work in question. The machine for welding longitudinal seams is especially designed to facilitate rapid and easy production, a pneumatic clamping device operated by a small lever gripping or releasing the work automatically. Both machines are arranged for pushbutton control within easy reach of the operators. The machine for circular welding revolves automatically while both ends are being welded.

The cycle of operation is simple. The sheet metal from which the tank proper is constructed is rolled the same as for riveting, tack welded in two places and then inserted into the longitudinal welding machine where the seam is automatically completed. The tank is then placed on the circular welding machine, where the heads and bottoms are both welded at once. Specially trained employes or experienced welders are not needed for the operation of the welding machines; any good workman can be trained for the purpose. A hand welder is usually employed, however, for tacking and sometimes for welding "spuds," or inlet and outlet nipples.

Plans for the immediate erection of a large warehouse and office building at Santa Fe Avenue and Fifty-second Street, Los Angeles, Calif., by the General Electric Company, have just been announced. The plant, which is to be used as a distributing center, will cost about $1,000,000, including land, buildings and equipment.

The plans being prepared by the Austin Company, of California, call for a warehouse three stories high and designed to handle four additional floors. The warehouse, besides housing handling machinery to move the stock, will include a cafeteria for employes.

Motor For Gaseous Mines

A new type of totally enclosed motor with control, especially adapted for use in gaseous mines and designed by the General Electric Company, has successfully passed the tests of the U. S. Bureau of Mines. This equipment, the first to pass the tests, will be approved by this bureau as a permissible motor for this service when used with a suitable mine pump or other device to which it may be applied as a means of drive. The primary use for which the motor was designed is for driving mine gathering pumps, but it is expected that other uses will be developed.

The motor is a direct-current machine, and so far has been made in but one rating—5 horsepower, 900 R.P.M., 550 volts, compound wound. Other ratings, however, are to be designed and submitted for approval as required. The General Electric designation for the new motor is Type ME-6, Class BM construction.

The development of the ME-6 motor followed insistent demands from the mining industry for a permissible motor for small pump work. The method of construction followed is total enclosure, using very wide machined flanges for all joints, rather than the use of baffle plates for cooling escaping gases from internal explosions. There are no through bolt holes, all bolt holes being bottomed. The control switch is built on the same principle and is mounted directly on the motor.

The motor is started by being thrown directly across the line. No fuses are used in the control, protection being secured by a thermal overload relay.

When the cover is removed from the controller, all circuits are automatically killed except two shielded terminals of the incoming line. It is thus impossible to start the motor or draw an arc with the controller cover removed unless it is done maliciously.

By means of this construction no heat, from any cause, whether sparking or explosion, can be transmitted to the outside of the motor in such intensity as to ignite any gases surrounding the equipment. The Bureau of Mines states that this is the first complete, self-contained motor and control unit submitted.

Antiquity of Mineral Screening Apparatus

Screening apparatus may be older than civilization, state E. A. Holbrook and Thomas Fraser, in Bulletin 234, on screen sizing of coal, ores, and other minerals, just published by the Bureau of Mines. The coarsely woven baskets or the rough cloth used by primitive people for carrying loose materials may have suggested the idea; even before this one experience of picking up a handful of beach sand and having it sift gently through the fingers might have supplied the idea for a bar screen.

In the Middle Ages Agricola described the application of screens, used both wet and dry, in metal mining. His illustra-

tions show hand screens not unlike the common hand riddles used today, except that, as metals were scarce, such a screen was often only a wooden trough with holes bored at intervals.

One of the first modern references to coal-mining screens gives the following information for 1740: "In this year the mischievous practice of screening coals was first introduced at Willington colliery by Mr. William Brown." At first the screen apertures were made very narrow, but by 1770 the bars were placed farther apart, widening the openings considerably. Since coal operators and miners in this country have had numerous disputes on the use of screens in the past 30 years, it is interesting to note that more than 150 years ago the practice of screening coal was termed "mischievous," and that record was made of the enlargement of the apertures.

Announcement is made of the consolidation of the Wier Frog Company and the Kilby Frog and Switch Company, to be known as Wier Kilby Corporation. O. DeG. Vanderbilt, Jr., is President; E. M. Kilby, 1st Vice President, and J. K. Lansdowne, Vice President. The sales offices and plants will be located at Cincinnati, Ohio and Birmingham, Ala.

Bulletins Nos. 29 and 40 have just been published by the **Hardinge Company**, of York, Pa., and New York City. No. 29 deals with the Hardinge Motor Spray for Gas Scrubbing, Air Conditioning, Absorption, Concentration, Mixing, Aeration, Heating and Cooling. It is completely illustrated with photographs and diagrams. No. 30 deals with the Hardinge Super Thickener and Clarifier, which also is thoroughly illustrated with photographs and graphs. Copies may be obtained upon request to their home office, or any of their branch offices.

General Electric Company, Schenectady, N. Y., have issued a beautiful new catalog upon the subject of Automatic Switching Equipment, for reclosing service on 275 volt D. C. circuits. The catalog, which is well illustrated, gives complete information concerning this equipment, together with definitions for stub and multiple feed; how to operate a stub-reclosing feeder and a stub-multiple reclosing feeder; how to choose the correct size of feeder and a list of Automatic Reclosing Feeders in service.

Chicago Steel & Wire Company has just issued a booklet on Properties of Steel Filler Rods for Gas and Electric Welding. Their announcement states that the subject matter of this book has been developed by their research department, and is published for the first time. The material is entirely new and answers many questions which have hitherto been unanswered. Copies available upon request to their Chicago office, 103d Street and Torrence Avenue.

American Manganese Steel Company, Chicago Heights, Ill., has just made announcement of their entry into the field of alloys for resisting high-temperature and corrosive conditions, through the placing upon the market of their Amsco product, "Fahralloy" castings. They just have issued a catalog dealing with this product, which contains an exhaustive treatise upon the subject. Full information may be obtained upon request for Section 26 of their recently issued catalog.

The Austin Company, Cleveland, Ohio, have just issued a beautiful new book known as the "Austin Book of Buildings." It is handsomely bound, and illustrated. Among its more important features are: Cost of building trend with a chart showing seven-year period; multi-story—single-story building trend, with chart; chart showing decentralization in manufacturing and distribution; table of comparative insurance rates; ten pages of technical matter covering advantages, relative costs of various types of floors, doors, walls, roofs, etc. A copy of this book may be had upon request to the home office of the company.

PERSONAL ITEMS

Jules Labarthe, of San Francisco, has accepted the position of general manager of the Georgian Manganese Co., Ltd., which is to develop the manganese deposits in the vicinity of Tchiaturi, Caucasus, 110 miles from the Black Sea.

The United Verde Copper Company, Clarkdale, Ariz., has retained **H. Kanyon Burch** in the capacity of consulting engineer to supervise the design and construction of the proposed concentrating plant to be built by that company at Clarkdale.

W. H. D. Gibson has been elected vice-president of the J. K. Dering Coal Company, of Chicago, with which company he has been associated since its organization.

T. F. Brown, of Pittsburgh, for ten years a mining engineer with the Clemens Coal Company in the southeastern Kansas field, has entered the service of the Bureau of Mines as a first-aid and mine rescue expert, assigned to Car No. 10, operating in Iowa and Missouri.

B. M. O'Harra, acting superintendent of the Mississippi Valley Station of the Bureau of Mines, has resigned to accept the position of chief chemist in the Research Department of the American Smelting and Refining Company, in charge of the research laboratory which that company has established at Perth Amboy, N. J.

Mr. O'Harra's successor at Rolla is **H. M. Lawrence**, who has been on the staff of the Reno station of the Bureau of Mines during the past year and was before that with the Kennecott Corporation in Alaska.

Marshall J. H. Jones, vice-president of the Bertha-Consumers Company and personal assistant to his father, is making calls upon all friends and customers of the company. Mr. Jones is studying the sales and financial ends of the coal business, having spent several years in the operating division at the mines as a general superintendent.

James W. Wade, assistant manager for the Tintic Standard Mining Company, has been named as a regent of the University of Utah by Governor George H. Dern. The Utah School of Mines, of which Mr. Wade is a graduate, is a part of the University.

Dr. Edward Sampson, associate geologist, U. S. Geological Survey, has been appointed assistant professor of geology at Princeton University.

John S. Lutes, a former well-known iron mining man of Duluth, Minn., and who last winter moved to California, has purchased the Eaton Canyon Rock & Sand Company, of Pasadena. Mr. Lutes was for many years general manager of mines for the Tod-Stambaugh Company.

Maj. H. D. Moore, of Rock Springs, Wyo., has been appointed oil inspector for the State land board by Governor Ross. Major Moore was formerly one of the superintendents of the Midwest Refining Company in the Salt Creek field.

Judge E. H. Gary, chairman of the United States Steel Corporation, celebrated his 79th birthday October 8.

Norman A. Elmslie, chief engineer of the Bethlehem Mines Corporation in West Virginia, has been appointed division superintendent in the State to succeed **M. Benton Mitchell**, who has accepted a position with the West Virginia Coal & Coke Company.

Wilbur A. Nelson is now at the University of Virginia, Charlottesville, as head of the department of geology of the university and director of the Virginia Geological Survey.

Harold O. Davidson, superintendent in charge of sinking the Geneva mine shaft for the Oliver Iron Mining Company, Ironton, Mich., has resigned to accept a position as mining engineer with the Michigan Conservation Department, with headquarters at Lansing. He also will assist Engineer Barrett, of the Michigan Geological Department, in the appraisal of iron, copper, and other mines in the State.

Courtenay De Kalb, of Tucson, Ariz., has been appointed head of the department of mines of the University of Alabama.

A. J. Maclean, of San Francisco, has been appointed general purchasing agent of the Utah Copper Company and its subsidiary companies, succeeding **R. E. Clarke**, resigned.

Charles F. Willis, editor and publisher of the Arizona Mining Journal, has been elected governor of the Southwest district of Kiwanis Clubs. The Southwest district includes Arizona, New Mexico and west Texas.

J. D. A. Morrow, former vice-president of the National Coal Association, has been placed in charge of sales for Indiana and Illinois by the Joy Coal Loading Machine Company.

Spencer Howell, formerly superintendent of the Tucson station of the Bureau of Mines, will assist Dr. Charles E. Munroe, chief explosive chemist, Bureau of Mines, Washington. The work of the explosive department is to enlarge in the near future.

R. M. Lambie, chief of the Department of Mines of West Virginia, was in Washington recently in conference with T. T. Read, director of safety of the U. S. Bureau of Mines, the occasion of the conference being to formulate plans for a cooperative study of the subject of falls of roof and coal.

F. B. Tough, engineer in charge of the Mineral Leasing Division of the Geological Survey, has resigned to accept a position with the Humphreys Corporation, Houston, Tex.

E. P. Campbell, of the U. S. Geological Survey, has been transferred to the Bureau of Mines as superintendent of the Bartlesville, Okla., station of the bureau.

A. P. Cameron, who has been general manager of the mines of the Westmoreland Coal Company, Irwin, Pa., for many years, has been elected vice-president in charge of operations.

Dr. G. H. Cady, head of the department of geology of the University of Arkansas, Fayetteville, will return to the staff of the Illinois Geological Survey the first of the year, in charge of coal studies, to succeed **Dr. H. E. Culver**, who has accepted the position as head of the department of geology at Washington State College.

C. O. Buckingham

Lest We Forget That This Is November

—The—

Leahy No Blind Screen

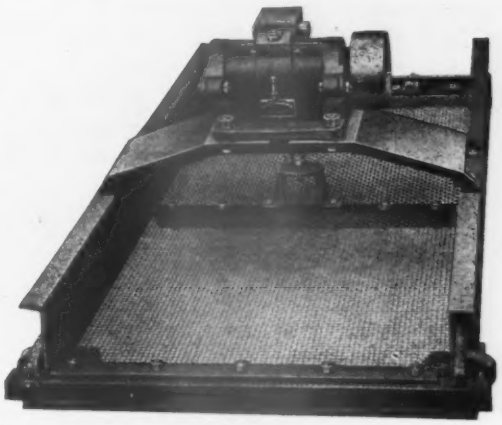
1600 Vibrations per minute

Screens Ores, Rock, Sand, Slag, Cement

Wet or Dry

Absolutely NON-BINDING

Solid All Metal Construction



One large Lead Company has 100 Leahy screens in constant use

Very large tonnages are screened with only ½ H. P.

Annual Repair expense about 1% of first cost

Manufactured and sold by

THE

DEISTER CONCENTRATOR COMPANY

635 High St., FORT WAYNE, IND.

MAIL CARD TODAY FOR BULLETIN No. 12

Above, VANO Blower

Coppus Portable Blowers

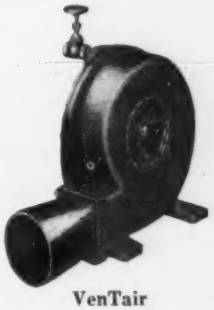
FOR MINE VENTILATION

Compressed Air Driven — Electric Motor Driven

Deliver from 30% to 40% more air per minute than any other blowers of same diameter—under same conditions.

Very compact and light weight. Handled and carried easily. For given capacity and static pressure, require less floor space than any other blower.

Absolutely reliable, sturdy and "fool-proof." Need no attention except an occasional setting-up of grease cup. Once in, may be practically forgotten.



VenTair

Write us for additional data and prices, or ask our representatives:

Mine & Smelter Equipment Co. Phoenix, Ariz.

Luitwieler Pumping Engine Company Los Angeles, Calif.

Main Iron Works San Francisco, Calif.

Stearns-Roger Mfg. Co. Denver, Colo.

P. W. Belcher Dooly Blk. Salt Lake City, Utah

Ben. F. Evans Morier Apts., No. 5 Butte, Mont.

The Percy E. Wright Engineering Co. Seattle, Wash.

John C. Glenn Apartado 46, Bis. Mexico City, D. F.

Coppus Engineering Corporation 343 Park Avenue Worcester, Mass.

BUYER'S DIRECTORY

ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc., 30 E. 42nd St., N. Y. C.

ACETYLENE GAS
Prest-O-Lite Co., 30 East 42nd St., New York City.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

APPLIANCES, ENGINEERING
The Lunkenheimer Co., Cincinnati, Ohio.

AUTOMATIC CAR CAGES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

AUTOMATIC FEEDERS, GRAVITY
G. M. Johnson Mfg. Co., Jeannette, Pa.

AUTOMATIC (Mine Doors, Truck and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC SWITCH THROWERS
G. M. Johnson Mfg. Co., Jeannette, Pa.

AUTOMATIC WEIGHING MACHINES
Streeter-Amet Weighing & Recording Co., Chicago, Ill.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co., 30 East 42nd St., New York City.

BATTERY SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

BEARINGS (Roller)
Hyatt Roller Bearing Co., Harrison, N. J.

BELTING (Conveyor, Elevator, Transmission)
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

BINS (Coke and Coal)
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

BIT SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.

BLACK DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLASTING POWDER
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLOWERS, CENTRIFUGAL
Ingersoll-Rand Co., 11 Broadway, New York City.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

BOILER MOUNTINGS
The Lunkenheimer Co., Cincinnati, Ohio.

BREAKERS (Construction and Machinery)
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Wilmot Engineering Co., Hazleton, Pa.

BUCKETS (Elevator)
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CABLES
American Steel & Wire Co., Chicago and New York.

CABLES (Connectors and Guides)
American Mine Door Co., Canton, Ohio.

CABLEWAYS
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.

CAGE (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGERS, AUTOMATIC
G. M. Johnson Mfg. Co., Jeannette, Pa.

CAGES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
G. M. Johnson Mfg. Co., Jeannette, Pa.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.
Traylor Engineering & Mfg. Co., Allentown, Pa.

CARBON AND BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON BURNING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CAR HAULS
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CAR WHEEL BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CASTINGS
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAIN RAIL CAR HAULS
G. M. Johnson Mfg. Co., Jeannette, Pa.

CHAINS
Jeffrey Mfg. Co., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, DRIVE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CHEMICALS
Roessler & Hasslacher Chemical Co., 709-717 Sixth Avenue, New York.

CHEMISTS
Hunt, Robt., Company, Insurance Exchange, Chicago, Ill.

CHILI MILL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

CLAMPS (Trolley)
Ohio Brass Co., Mansfield, Ohio.

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

COAL COMPANIES
General Coal Company, Land Title Bldg., Philadelphia, Pa.
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.
Bertha-Consumers Company, Chamber of Commerce Bldg., Pittsburgh, Pa.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

COAL HANDLING MACHINERY
Jeffrey Mfg. Co., 958 N. Fourth St. Columbus, Ohio.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

COAL LOADERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg Co., Halsted St. and 48th Pl., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

COAL MINING PLANTS
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

COCKS (Locomotive, Cylinder and Gauge)
The Lunkenheimer Co., Cincinnati, Ohio.

COKE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.

CONCENTRATING PLANTS
Traylor Engineering & Mfg. Co., Allentown, Pa.

Your source of dissolved acetylene becomes not one source but 102 if you use

Prest-O-Lite
DISSOLVED ACETYLENE

THE PREST-O-LITE COMPANY, INC.
Oxy-Acetylene Division

General Offices: Carbide and Carbon Bldg., 30 East 42d St., New York
In Canada: Prest-O-Lite Co. of Canada, Limited, Toronto

31 Plants—71 Warehouses—22 District Sales Offices

A Prest-O-Lite PRODUCT
WORLD'S LARGEST MANUFACTURER OF ACETYLENE THE GAS OF A THOUSAND USES
BATTERIES FOR AUTOMOBILES FARM LIGHTING RAILWAY SIGNALS AND RADIO

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago and New York

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

CONTROLLERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

CONVERTORS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Traylor Engineering & Mfg. Co., Allentown, Pa.

CONVEYOR BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CONVEYORS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, BELT
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.
Wilmot Engineering Co., Hazleton, Pa.

CONVEYORS, COAL
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, PAN OR APRON
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CORE DRILLING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

COUPLINGS, FLEXIBLE
Fawcus Machine Co., Pittsburgh, Pa.

CROSSINGS AND CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.

CRUSHER SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

CRUSHERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

CRUSHERS, COAL
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CRUSHERS, JAW
Traylor Engineering & Mfg. Co., Allentown, Pa.

CRUSHERS (Gyratory)
Traylor Engineering & Mfg. Co., Allentown, Pa.

CRUSHERS, SINGLE & DOUBLE ROLL
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42nd St., New York City.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CYANIDE
American Cyanamid Co., New York, N. Y.
Roessler and Hasslacher Chemical Company, 709 Sixth Avenue, New York City.

CYANIDE PLANTS
Traylor Engineering & Mfg. Co., Allentown, Pa.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

DESIGNERS OF PLANTS
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DIAMOND CORE DRILL CONTRACTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

DIAMOND DRILLING CARBON
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
R. S. Patrick, Sellwood Building, Duluth, Minn.

DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DOUBLE CRIMPED WIRE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

DREDGES, GOLD AND TIN
New York Engineering Co., 2 Rector St., New York City.

DRIFTERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLING, DIAMONDS FOR
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Blast Hole)
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, CORE
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILLS, ELECTRIC
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

DRILLS, HAMMER
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Hand Operated Coal)
Ohio Brass Co., Mansfield, Ohio.

DRILLS, PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, PROSPECTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.
New York Engineering Co., 2 Rector St., New York City.

DRILLS, ROCK
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.

DRIVES, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DRYERS
Traylor Engineering & Mfg. Co., Allentown, Pa.

DUMP CARS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

DYNAMITE
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

DYNAMOS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

ELECTRICALLY OPERATED VALVE
The Lunkenheimer Co., Cincinnati, Ohio.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

ELECTRIC LOCOMOTIVES
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC MINE SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC WIRES AND CABLES
American Steel & Wire Co., Chicago and New York.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.

ELEVATORS
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Traylor Engineering & Mfg. Co., Allentown, Pa.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ELEVATORS, BUCKET
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ELEVATOR MACHINERY
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ENGINE TRIMMINGS
The Lunkenheimer Co., Cincinnati, Ohio.

ENGINEERING APPLIANCES
The Lunkenheimer Co., Cincinnati, Ohio.

ENGINES
Lidgerwood Mfg. Co., 96 Liberty St., New York City.

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

ENGINES, OIL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway New York City.

ENGINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINEERS
H. R. Ameling Prospecting Co., Rolla, Mo.
Hunt, Robert Company, Insurance Exchange, Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

EXPLOSIVES
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

FAN DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

FEEDERS, ORE
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Traylor Engineering & Mfg. Co., Allentown, Pa.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

FILTER WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FLOTATION OILS
Hercules Powder Co., 934 King St., Wilmington, Del.

FLOW METERS
General Electric Co., Schenectady, N. Y.

FLUX, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

FORGINGS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FROGS AND SWITCHES
Central Frog & Switch Co., Cincinnati, Ohio.

FURNACES (Copper, Lead, Blast)
Traylor Engineering & Mfg. Co., Allentown, Pa.

FURNACES (Reverberatory)
Traylor Engineering & Mfg. Co., Allentown, Pa.

PATRICK CARBON
for Diamond Core Drilling

Its
Reliability
Means
Economical
Drilling

R. S. PATRICK
Duluth, Minnesota, U.S.A.
Cable Address, "Exploring" Duluth

O-B Products are always developed to establish the highest possible standard of performance—not to meet a price.

The O-B organization has consistently followed this policy for 36 years.

The Ohio Brass Company
Mansfield, Ohio

SURE
TO OPEN

CANTON
AUTOMATIC
MINE
DOORS

Safeguard Life—Positive in operation — Open and close quickly — Simple in construction — Built for service —Prevent explosions—Conserve air.

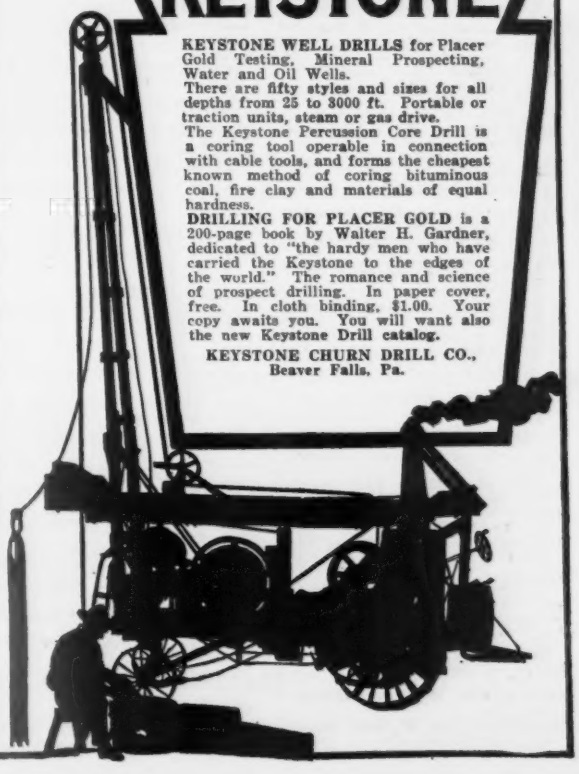
NO INVESTMENT REQUIRED
ABSOLUTELY NONE
ASK US HOW WE DO IT
4000 IN USE

Can be Leased or Bought. Rental price per month saved in a few days. Purchase price saved in a few months.
Write for Catalog

American Mine Door Co.
916 Robin St.
Canton, Ohio

SURE
TO CLOSE

KEYSTONE



KEYSTONE WELL DRILLS for Placer Gold Testing, Mineral Prospecting, Water and Oil Wells.
There are fifty styles and sizes for all depths from 25 to 3000 ft. Portable or traction units, steam or gas drive.
The Keystone Percussion Core Drill is a coring tool operable in connection with cable tools, and forms the cheapest known method of coring bituminous coal, fire clay and materials of equal hardness.
DRILLING FOR PLACER GOLD is a 200-page book by Walter H. Gardner, dedicated to "the hardy men who have carried the Keystone to the edges of the world." The romance and science of prospect drilling. In paper cover, free. In cloth binding, $1.00. Your copy awaits you. You will want also the new Keystone Drill catalog.

KEYSTONE CHURN DRILL CO.,
Beaver Falls, Pa.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Traylor Engineering & Mfg. Co., Allentown, Pa.

GAS (Cutting, Welding) . .
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

GAS (Nitrogen, Oxygen)
Linde Air Products Co., 30 E. 42nd St., New York City.

GAUGES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GEARS
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS, BEVEL
Fawcus Machine Co., Pittsburgh, Pa.

GEARS, HERRINGBONE
Fawcus Machine Co., Pittsburgh, Pa.

GEARS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

GEARS, SPUR
Fawcus Machine Co., Pittsburgh, Pa.

GEARS, WORM
Fawcus Machine Co., Pittsburgh, Pa.

GEARS, WORM WHEELS
Fawcus Machine Co., Pittsburgh, Pa.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

GENERATORS, ACETYLENE
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GLOVES, ASBESTOS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GOGGLES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

HANGERS (Insulated Trolley)
Ohio Brass Co., Mansfield, Ohio.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

HEADLIGHTS, ARC AND INCANDESCENT
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Ohio Brass Co., Mansfield, Ohio.

HERRINGBONE GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

HOIST DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

HOISTS
American Steel & Wire Co., Chicago and New York.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

HOISTS, PORTABLE
Ingersoll-Rand Co., 11 Broadway New York City.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.

HOISTS, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.

HOISTS (Room and Gathering)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Lidgerwood Mfg. Co., 96 Liberty St., New York City.

HOISTING ROPES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

HOSE, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

HOSE, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

INSULATORS, FEEDER WIRE
Ohio Brass Co., Mansfield, Ohio.

INSULATORS, SECTION
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Porcelain)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Third Rail)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

INSULATED WIRE AND CABLE
American Steel & Wire Co., Chicago, Ill.
Roebling Sons, John A., Trenton, N. J.

KILNS (Rotary)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

LAMPS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

LOADERS (Mine Car)
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS, PORTABLE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOCOMOTIVES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

LOCOMOTIVES, RACK RAIL
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

LOCOMOTIVES, STORAGE BATTERY
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

MACHINERY, TRANSMISSION (Power)
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

MANIFOLDS, OXYGEN
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

MILLS, ROD & BALL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Traylor Engineering & Mfg. Co., Allentown, Pa.

MILLS, STAMP
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Traylor Engineering & Mfg. Co., Allentown, Pa.

MILLS (Tube)
Traylor Engineering & Mfg. Co., Allentown, Pa.

MINE CAR BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

MINE DOORS, AUTOMATIC
American Mine Door Co., Canton, Ohio.

MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

MINING MACHINES
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

MINING MACHINES CHAIN AND PUNCHER
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

MINING MACHINES (Electric)
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

MINING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.

MINE SIGNALS
American Mine Door Co., Canton, Ohio.

MOTORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

MOUNTINGS, BOILER
The Lunkenheimer Co., Cincinnati, Ohio.

NITROGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

NON-RETURN BOILER STOP VALVES
The Lunkenheimer Co., Cincinnati, Ohio.

ORE, BUYERS AND SELLERS OF
Irvington Smelting & Refining Works, Irvington, N. J.
Phelps-Dodge Corporation, New York City.

OXYGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

PACKINGS
Greene, Tweed & Co., 109 Duane St., New York City.

PATENT ATTORNEY
John Boyle, Jr., Ouray Bldg., Washington, D. C.

PERMISSIBLES, Explosives
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

PICKING TABLES
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.

PIPE (Wood)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PNEUMATIC TOOL
Ingersoll-Rand Co., 11 Broadway, New York City.

POWDER, BLASTING
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

PREHEATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

PROSPECTIVE DRILLS
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

PULLEYS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

PULVERIZER SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

PULVERIZERS, COAL AND COKE
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

PUMPS, AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aurora Pump & Mfg. Co., Aurora, Ill.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, MINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aurora Pump & Mfg. Co., Aurora, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

ROCK DUSTING

in the most thorough and efficient manner is rapidly accomplished with

The **Legrabon** MINE DUSTING MACHINE

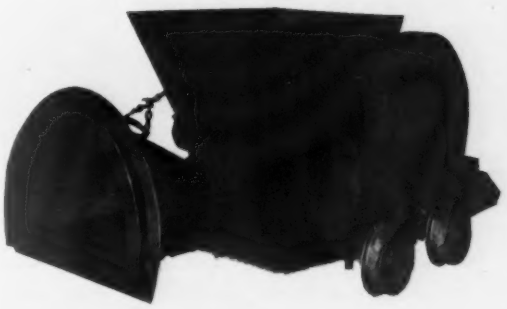
due to its positive feed, large capacity, high velocity of discharge and the peculiar construction of the nozzle.

Unvarying good performance in actual rock dusting practice for several months past has proven it a finished product and not an experiment.

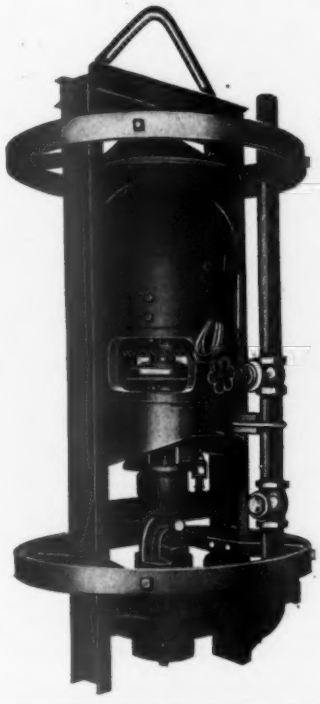
Our new bulletin gives the details.

DIAMOND MACHINE COMPANY
Monongahela, Pa.

Selling Agents: Cooke-Wilson Electric Supply Company
Pittsburgh, Pa., Athens, Ohio, Charleston, W. Va.



Pumps—AURORA—Pumps
For
MINES and INDUSTRIES



Illustrating an AURORA Mine-Sinker, Centrifugal Pump with motor attached.

Can be lowered and raised to suit conditions.

Made in any size and for any capacity.

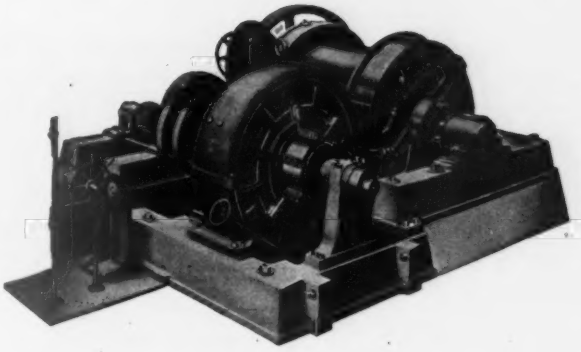
Also a full line of all mine-water, bronze, centrifugal pumps. Horizontal and vertical.

DEEP WELL TURBINES

Aurora Pump & Mfg. Co.
Aurora, Illinois

The Connellsville Manufacturing and Mine Supply Company

Connellsville, Pa.



If you need any cost reducing mine equipment, write us.

The Cage, Hoist and Fan Builders

THE MINING ANNUAL

The Annual Convention of the American Mining Congress will be held in Washington, D. C., from December 9th to December 11th. This is the most important mining event of the year. It will be featured fully in the December issue of the Mining Congress Journal. This Convention edition, through the importance of its reviews, and from the significance attached by all mining men, has come to be recognized as

The MINING ANNUAL

PUMPS (Electric)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aurora Pump & Mfg. Co., Aurora, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, POWER
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, VACUUM
Ingersoll-Rand Co., 11 Broadway, New York City.

QUARRYING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.

RAIL BONDS
American Steel & Wire Co., Chicago and New York.
Ohio Brass Co., Mansfield, Ohio.

RAILWAY SUPPLIES
Ohio Brass Co., Mansfield, Ohio.

REFINING PLANTS (Lead)
Traylor Engineering & Mfg. Co., Allentown, Pa.

REGULATORS, Welding, Compressed Gas
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

REK-TANG ROLLED SLOT SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

RELIEF VALVE
The Lunkenheimer Co., Cincinnati, Ohio.

RIDDLE WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

ROCK DRILLS
Ingersoll-Rand Co., 11 Broadway, New York City.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.

RODS, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

ROLLER BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

ROLLS (Crushing)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Traylor Engineering & Mfg. Co., Allentown, Pa.

ROPE
American Steel & Wire Co., Chicago and New York.

ROPE, TRANSMISSION
American Steel & Wire Co., Chicago and New York.
Roebling Sons, John A., Trenton, N. J.

ROPE, WIRE
American Steel & Wire Co., Chicago and New York.
Roebling Sons, John A., Trenton, N. J.

SAFETY APPLIANCES, MINE
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

SAFETY HORN CAR STOPS
S. M. Johnson Mfg. Co., Jeannette, Pa.

SAMPLERS
Traylor Engineering & Mfg. Co., Allentown, Pa.

SCRAPER LOADERS
Goodman Mfg Co., Halsted St. and 48th Place, Chicago, Ill.

SCREEN WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

SCREENS, REVOLVING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Traylor Engineering & Mfg. Co., Allentown, Pa.

SCREENS, SHAKER
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS (Trommel)
Traylor Engineering & Mfg. Co., Allentown, Pa.

SCREENS AND PERFORATED SHEETING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SHARPENERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

SIEVE WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

SIGNS (Mine)
Stonehouse Signs, Inc., 842 Larimer St., Denver, Colo.

SINKERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway New York City.

SKIPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Traylor Engineering & Mfg. Co., Allentown, Pa.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SMELTERS
Irvington Smelting & Refining Works, Irvington, N. J.
Traylor Engineering & Mfg. Co., Allentown, Pa.

SPECIAL MACHINERY
Fawcus Machine Co., Pittsburgh, Pa.

SPEED REDUCERS
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SPEED REDUCERS, DOUBLE
Fawcus Machine Co., Pittsburgh, Pa.

SPEED REDUCERS, SINGLE
Fawcus Machine Co., Pittsburgh, Pa.

SPLICE, CABLE
American Mine Door Co., Canton, Ohio.
Ohio Brass Co., Mansfield, Ohio.

SPLICE, INSULATOR
American Mine Door Co., Canton, Ohio.

SPLICE, TROLLEY WIRE
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

SPROCKETS, COMPENSATING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SPROCKETS, SPRING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPUR GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

STAMP MILL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

STEEL, ALLOY
Central Steel Co., Massillon, Ohio.

STEEL, HIGH FINISH SHEET
Central Steel Co., Massillon, Ohio.

STEEL, HOLLOW & SOLID DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

STEEL, REINFORCING
American Mine Door Co., Canton, Ohio.

STEEL, STRIP
Central Steel Co., Massillon, Ohio.

STOPERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway New York City.

STORAGE BATTERY LOCOMOTIVES
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Mancha Storage Battery Locomotive Co., St. Louis, Mo.

SWITCHBOARDS, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

SWITCHES (Disconnecting and Electric)
General Electric Co., Schenectady N. Y.

SWITCHES AND FROGS, TROLLEY
American Mine Door Co., Canton, Ohio.
Central Frog & Switch Co., Cincinnati, Ohio.
Ohio Brass Co., Mansfield, Ohio.

TIES, (Steel, Mine)
Central Frog & Switch Co., Cincinnati, Ohio.

TIMBER PRESERVING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TIPPLES
Jeffrey Mfg. Co., 958 N. 4th St., Columbus, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

TIPPLE EQUIPMENT
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

TORCHES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

TRACKS, PORTABLE, RAIL, ETC.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRACK, (Portable, Assembled and Unassembled, Riveted or Bolted),
Central Frog & Switch Co., Cincinnati, Ohio.

TRACK SUPPLIES
Central Frog & Switch Co., Cincinnati, Ohio.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TRANSMISSION, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

TRIMMINGS, ENGINE
The Lunkenheimer Co., Cincinnati, Ohio.

TROLLEY FROGS
Ohio Brass Co., Mansfield, Ohio.

TROLLEY (Hangers and Clamps)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

TROLLEY MATERIAL, OVERHEAD
Ohio Brass Co., Mansfield, Ohio.

TROLLEY WHEELS AND HARPS
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Ohio Brass Co., Mansfield, Ohio.

TRUCKS, WELDER'S
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

TURBINES, HYDRAULIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TURBINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

VALVES
The Lunkenheimer Co., Cincinnati, Ohio.
Ohio Brass Co., Mansfield, Ohio.

VALVES, Back Pressure, Pressure Reducing
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

WAGON LOADERS
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

WASHERIES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

WASHER SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

WATER JACKETS (Smelting Furnace)
Traylor Engineering & Mfg. Co., Allentown, Pa.

WATER RELIEF VALVES
The Lunkenheimer Co., Cincinnati, Ohio.

WEIGHING MACHINES (Automatic)
Streeter-Amet Weighing & Recording Co., Chicago, Ill.

WEIGHT RECORDING MACHINES (Automatic)
Streeter-Amet Weighing & Recording Co., Chicago, Ill.

WELDING and CUTTING APPARATUS, Etc. (Oxy-Acetylene)
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

WELDING APPARATUS, ELECTRIC ARC
Ohio Brass Co., Mansfield, Ohio.

WELDING GAS
Prest-O-Lite Co., Inc., 30 E. 42nd St., New York City.

WELDING SUPPLIES
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

WHISTLES
The Lunkenheimer Co., Cincinnati, Ohio.

WIRE AND CABLE
American Steel & Wire Co., Chicago and New York.
Roebling Sons, The John A., Trenton, N. J.

WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

WIRE ROPE FITTINGS
American Steel & Wire Co., Chicago and New York.

WIRE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

WIRE, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

WORM GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

CORE DRILLING

H. R. AMELING PROSPECTING COMPANY, INC.

Diamond Drill Contractors

20 Years' Continuous Service
Not a Dissatisfied Customer

ROLLA, MISSOURI

Home: State Geologic Survey, Missouri School of Mines

The West Virginia Rail Co.

Manufacturers
STEEL RAILS
ACCESSORIES
FROGS and SWITCHES
STEEL MINE TIES
DEFORMED REINFORCING BARS
Mills and General Offices
HUNTINGTON
W. VIRGINIA

New York Engineering Co.

"Empire"

Gold and Tin Dredges
Prospecting Drills
Hydraulic Gravel Elevators
Giants, Sluices, Pipe Lines

NEW YORK ENGINEERING COMPANY
2 RECTOR STREET NEW YORK

Irvington Smelting and Refining Works

Buyers, Smelters and Refiners of
Gold, Silver, Lead, Copper and Platinum
Ores, Sweeps and Bullion

Manufacturers of Copper Sulphate

IRVINGTON :-: NEW JERSEY

NEW YORK OFFICE—Charles Engelhard
Hudson Terminal Building 30 Church Street

Phelps Dodge Corporation

99 JOHN STREET - - NEW YORK

MEMBER COPPER & BRASS RESEARCH ASSOCIATION

Copper

"C ★ Q" Electrolytic

"P. D. Co." Casting

PACIFIC TANKS

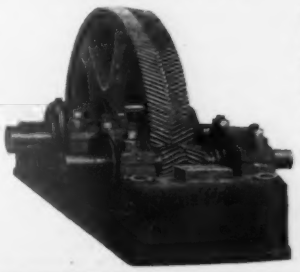
Represent 35 years' experience in wood tank construction. Made of clear California Redwood or Douglas Fir, in capacities up to 650,000 gallons. Not affected by acids, salts or alkali. Catalog and prices on request.

PACIFIC TANK & PIPE CO.
THE STANDARD SINCE 80
332 Market St., San Francisco, Calif.
103 Park Ave., New York City, N.Y.

Are Operating Problems Worrying You ?

If your Practical Operating problems are a cause of worry to you, we believe you will be helped materially by turning to our new feature, The Practical Operating Men's Department to be found in this and following issues.

FAWCUS



Use Fawcus Herringbone Gear Drives for driving your hoists, fans, conveyors, picking tables, pumps and compressors. They save 25% to 50% in maintenance and operating costs.

FAWCUS MACHINE CO.
PITTSBURGH, PA.

American Mining Congress

OFFICERS AND COMMITTEES, 1925

OFFICERS

L. S. Cates, *President*
Daniel B. Wentz, *First Vice-President*
E. L. Doheny, *Second Vice-President*
Wm. H. Lindsey, *Third Vice-President*
J. F. Callbreath, *Secretary*

DIVISION STAFF

E. C. Porter, *Convention Manager*
George H. Bailey, *Counsel*
M. W. Kriegh, *Tax Division*
Dr. Henry Mace Payne, *Consulting Engineer*
E. H. Pullman, *Publicity Department*
E. R. Coombes, *Asst. to Secretary*

DIRECTORS

W. J. Loring, Los Angeles, Calif.
Bulkeley Wells, San Francisco, Calif.
Sidney J. Jennings, New York, N. Y.
Daniel B. Wentz, Philadelphia, Pa.
Albert J. Nason, Chicago, Ill.
Wm. H. Lindsey, Nashville, Tenn.
J. G. Bradley, Dundon, W. Va.
H. W. Seaman, Chicago, Ill.
E. L. Doheny, New York, N. Y.
Hugh Shirkie, Terre Haute, Ind.
Stanly Easton, Kellogg, Idaho.
F. L. Morse, Ithaca, N. Y.
L. S. Cates, Salt Lake City, Utah.

EXECUTIVE COMMITTEE

H. W. Seaman — Sidney J. Jennings
Albert J. Nason

WESTERN DIVISION

BOARD OF GOVERNORS

Robert E. Tally, United Verde Copper Co., Jerome, Ariz., *Chairman of the Division.*
W. B. Gohring, 419 Heard Building, Phoenix, Ariz., *Secretary of the Division.*
Arizona—Robert E. Tally, United Verde Copper Co., Jerome, Ariz.; W. B. Gohring, 419 Heard Building, Phoenix, Ariz.
California—W. J. Loring, 301 Merchants National Bank Bldg., Los Angeles, Calif.; Robert I. Kerr, 509 United Bank & Trust Co. Bldg., 625 Market St., San Francisco, Calif.
Colorado—Geo. A. Stahl, Room 12, State Capitol, Denver, Colo.; M. B. Tomblin, 436 State Office Building, Denver, Colo.
Idaho—A. P. Ramstedt, Wallace, Idaho; Ravenel Macbeth, Idaho Mining Association, Wallace, Idaho.
Nevada—Emmet D. Boyle, Mason Valley Mines Co., Mason, Nev.; Henry M. Rives, Nevada Mine Operators' Assn., Reno, Nev.
New Mexico—John M. Sully, Chino Copper Co., Hurley, N. M.; Jos. Woodbury, New Mexico Chapter, The American Mining Congress, Silver City, N. Mex.
Oregon—Robert M. Betts, Cornucopia Mining Co., Cornucopia, Oreg.
South Dakota—B. C. Yates, Homestake Mining Co., Lead, S. Dak.
Utah—V. S. Rood, Utah Apex Mining Co., Bingham, Utah; A. G. Mackenzie, 212 Kearns Building, Salt Lake City, Utah.
Washington—Raymond Guyer, Symons Building, Spokane, Wash.

SOUTHERN DIVISION

BOARD OF GOVERNORS

W. H. Lindsey, Napier Iron Works, Nashville, Tenn.
J. B. McClary, Yolande Coal & Coke Co., Birmingham, Ala.
Percy D. Berry, Providence Coal Mining Co., Providence, Ky.
Lee Long, Clinchfield Coal Corporation, Dante, Va.
S. L. Hertzog, Cherokee Mining Co., Spartanburg, S. C.
W. S. Peebles, The Paga Mining Co., Cartersville, Ga.
S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.
H. B. Flowers, New Orleans Public Service, Inc., New Orleans, La.
C. J. Griffith, Arkansas Central Power Co., Little Rock, Ark.
Dr. Joseph Hyde Pratt, Western North Carolina, Inc., Asheville, N. C.
W. H. Smith, Secy.-Mgr., Chamber of Commerce, Laurel, Miss.
C. A. Memminger (Florida), Pres., Coronet Phosphate Co., Asheville, N. C.

MANUFACTURERS DIVISION

OFFICERS

Honorary Chairman

N. S. Greensfelder, Hercules Powder Co., Wilmington, Del.

Chairman

J. C. Wilson, Ohio Brass Co., Mansfield, Ohio.

Vice-Chairmen

H. K. Porter, Hyatt Roller Bearing Co., Harrison, N. J.
C. L. Herbster, Hockensmith Wheel & Mine Car Co., Penn, Pa.
H. A. Buzby, Keystone Lubricating Co., Philadelphia, Pa.

Members

Atlas Powder Co., Wilmington Del. G. S. Scott.
Automatic Reclosing Circuit Breaker Co., Columbus, Ohio. C. M. Hickle.
Carnegie Steel Co., Pittsburgh, Pa. R. L. Twitchell.
Central Frog & Switch Co., Cincinnati, Ohio. E. R. Heitzmann.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. E. F. Carley.
Edison Storage Battery Co., Orange, N. J. G. E. Stringfellow.
General Electric Co., Schenectady, N. Y. L. W. Shugg.
Hercules Powder Co., Wilmington, Del. N. S. Greensfelder.
Hockensmith Wheel & Mine Car Co., Penn, Pa. C. L. Herbster.
Robt. Holmes & Bros., Inc., Danville, Ill. Grant Holmes, Pres.
Hyatt Roller Bearing Co., Newark, N. J. H. K. Porter.
Keystone Consolidated Publishing Co., Pittsburgh, Pa. Ralph C. Becker.
Keystone Lubricating Co., Philadelphia, Pa. H. A. Buzby.
Ludlow-Saylor Wire Co., St. Louis, Mo. Duncan Meier.
Mancha Storage Battery Locomotive Co., St. Louis, Mo. Raymond Mancha.
Myers-Whaley Co., Knoxville, Tenn. Wm. A. Whaley.
Morse Chain Co., Ithaca, N. Y. C. L. Saunders.
Ohio Brass Co., Mansfield, Ohio. J. C. Wilson.
John A. Roebling's Sons Co., Trenton, N. J. F. J. Maple.
Southern Wheel Co., St. Louis, Mo. F. C. Turner, Vice-Pres., 1308 Keystone Bldg., Pittsburgh, Pa.
Streeter-Amet Weighing & Recording Co., Chicago, Ill. H. F. Reck.
Timken Roller Bearing Co., Canton, Ohio. E. R. Phillips.
W. S. Tyler Co., Cleveland, Ohio. M. P. Reynolds.
Weir Kilby Corpn., Cincinnati, Ohio. J. K. Lansdowne.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. A. M. Staehle.

TAX DIVISION

GENERAL TAX COMMITTEE

Paul Armitage, *Chairman*
233 Broadway, New York, N. Y.
Geo. E. Holmes, *Vice-Chairman*
15 William St., New York, N. Y.

R. C. Allen, Hanna Building, Cleveland, Ohio.
A. Scott Thompson, Miami, Okla.
Wm. B. Gower, 20 Exchange Place, New York, N. Y.
R. V. Norris, 520 Second National Bank Bldg., Wilkes-Barre, Pa.
J. C. Dick, 511 Newhouse Bldg., Salt Lake City, Utah.
A. P. Ramstedt, Wallace, Idaho.
E. L. Doheny, 120 Broadway, New York City.
T. O. McGrath, Bisbee, Ariz.
Robt. N. Miller, Southern Bldg., Washington, D. C.
H. B. Fernald, 50 Broad St., New York City.
T. T. Brewster, Federal Res. Bank Bldg., St. Louis, Mo.
Wm. N. Davis, Bartlesville, Okla.

STANDARDIZATION DIVISION

Metal and Coal Mining Branches

COAL MINING BRANCH

General Committee

Colonel Warren R. Roberts (*Chairman*), Pres., Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.
R. L. Adams, Chf. Engr., Old Ben Coal Corpn., Christopher, Ill.
D. J. Carroll, Chicago, Wilmington & Franklin Coal Co., 332 South Michigan Ave., Chicago, Ill.
A. B. Kiser, Supt. of Elec. Equipment, Pittsburgh Coal Co., Pittsburgh, Pa.
J. A. Malady, Master Mech. & Elec. Engr., Hillman Coal & Coke Co., 2307 First Natl. Bank Bldg., Pittsburgh, Pa.
James Needham, Genl. Supt. of Mines, St. Paul Coal Co., 1368 Fullerton Ave., Chicago, Ill.
Fred Norman, Chf. Engr., Allegheny River Mining Co., Kittanning, Pa.
F. L. Stone, Industrial Engr. Dept., General Electric Co., Schenectady, N. Y.
C. H. Trik, Sales and Mine Ventilation Engr., Jeffrey Mfg. Co., Columbus, Ohio.

Underground Transportation
Fred Norman, *Chairman*

MAIN COMMITTEE

Fred Norman (*Chairman*), Chf. Engr., Allegheny Rivers Mining Co., Kittanning, Pa.
Frank S. Barks, Pres., Lincoln Steel and Forge Co., St. Louis, Mo.
Graham Bright, Cons. Engr., Howard N. Eavenson & Associates, 1302 Union Trust Bldg., Pittsburgh, Pa.
Jos. Bryan, Salesman, General Electric Co., 535 Smithfield St., Pittsburgh, Pa.
John T. Cherry, Genl. Supt., B. F. Berry Coal Co., Standard, Ill.
Frederick C. Coseo, Chf. Draftsman, Jeffrey Mfg. Co., Columbus, Ohio.
A. H. Ehle, Mgr., Domestic Sales, Baldwin Locomotive Works, 500 N. Broad St., Philadelphia, Pa.
W. J. Fene, Asst. Chf. Engr., Mine Safety Service, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh, Pa.
Robert J. Forester, Supt., Paradise Coal Co., Du Quoin, Ill.
J. B. Forrester, Chf. Engr., United States Fuel Co., Hiawatha, Utah.
D. F. Lepley, Pres. & Genl. Mgr., Connellsville Mfg. and Supply Co., Connellsville, Pa.
J. D. Martin, Genl. Supt. of Coal Mines, Virginia Iron, Coal & Coke Co., Payne Bldg., Roanoke, Va.
Charles M. Means, Cons. Engr., Charles M. Means Company, 447 Oliver Bldg., Pittsburgh, Pa.
James Milliken, Pres., Pittsburgh Testing Laboratory, P. O. Box 1115, Pittsburgh, Pa.
T. A. Parker, 407 Olive St., St. Louis, Mo.
Chas. H. Partington, Chief Engr., Cincinnati Frog & Switch Co., Cincinnati, Ohio.
H. K. Porter, Car & Truck Dept., Hyatt Roller Bearing Co., Newark, N. J.
G. H. Shapter, Commercial Engr., Industrial Dept., General Electric Co., Erie, Pa.
E. A. Watters, Genl. Supt., Hick Coal Companies, Box 405, Leechburg, Pa.
C. E. Watts, Mech. Engr., Berwind White Coal Mining Co., Windber, Pa.

SUB-COMMITTEE NO. 1—COAL MINE CAR DESIGN AND CONSTRUCTION

Arthur Neale (Chairman), Ass't. Genl. Mgr. of Mines, Pittsburgh Coal Co., 1018 Oliver Bldg., Pittsburgh, Pa.
H. M. Estabrook, Standard Steel Car Co., Frick Bldg., Pittsburgh, Pa.
W. K. W. Hansen, Plant Mgr., Hockensmith Wheel & Mine Car Co., Penn, Pa.
R. L. Kingsland, Genl. Supt., Power & Mechanical Dept., Consolidation Coal Co., Fairmont, W. Va.
James Milliken, Pres., Pittsburgh Testing Laboratory, P. O. Box 1115, Pittsburgh, Pa.
A. E. Ostrander, American Car & Foundry Co., 165 Broadway, New York City.
W. C. Sanders, Rwy. Equipment Engr., Timken Roller Bearing Co., Canton, Ohio.
C. E. Watts, Mech. Engr., Berwind White Coal Mining Co., Windber, Pa.
C. K. Witmer, Master Mechanic, Westmoreland Coal Co., Irwin, Pa.

SECTIONAL COMMITTEE ON TYPES OF HAND BRAKES

R. H. Kudlich (Chairman), U. S. Bureau of Mines, Washington, D. C.
Thos. G. Fear, Genl. Supt., Inland Collieries Co., Indianola, Pa.
Wm. J. Hill, Senior Mine Inspector, Travelers Insurance Co., 1103 Commonwealth Bldg., Pittsburgh, Pa.
W. H. Robinson, Chf. Inspector, The Associated Companies, 207 Fulton Bldg., Pittsburgh, Pa.

SECTIONAL COMMITTEE ON MINE CAR WHEELS

C. K. Witmer (Chairman), Master Mechanic, Westmoreland Coal Co., Irwin, Pa.
W. E. Farrell, Pres., Easton Car and Construction Co., Easton, Pa.
John M. Lewis, Chf. Engr., Houston Coal and Coke Co., 1532 Union Trust Bldg., Cincinnati, O.
Arthur Neale, Asst. Genl. Mgr. of Mines, Pittsburgh Coal Co., 1018 Oliver Bldg., Pittsburgh, Pa.
Cecil W. Smith, Chf. Engr., Illinois Coal Corpn., 1380 Old Colony Bldg., Chicago, Ill.
W. G. Srodes, Supt., Coal and Coke Dept., Shenango Furnace Co., Ligonier, Pa.

SUB-COMMITTEE NO. 2—MINE TRACKS AND SIGNALS

Chas. H. Partington (*Chairman*), Chf. Engr., Cincinnati Frog & Switch Co., Cincinnati, O.
Wm. P. Buckwalter, Vice-Pres., Martin J. O'Breire Co., 803 Union Bank Bldg., Pittsburgh, Pa.
G. M. Crawford, Crawford Machinery Co., 1117 Bessemer Bldg., Pittsburgh, Pa.
R. G. Crawford, Sales Engr., American Frog & Switch Co., 1207 Diamond Bank Bldg., Pittsburgh, Pa.
A. A. Culp, Birmingham, Ala.
R. G. Detmer, Chf. Engr., The American Frog & Switch Co., Hamilton, Ohio.

THORNE, NEALE & COMPANY., Inc.

FRANKLIN BANK BUILDING
1416 CHESTNUT STREET—9 A. M. to 4 P. M.
PHILADELPHIA, PA.

MINERS' AGENTS AND WHOLESALE DEALERS

Anthracite **COAL** ***Bituminous***

ANTHRACITE COLLIERIES

Mt. Lookout, Sterrick Creek, Harry E, Northwest, Forty Fort, Lackawanna, New Castle, Buck Run, Locust Run (Washery)

Pardee Bros. & Co.—Lattimer Lehigh

BITUMINOUS

Sonman, South Fork District—Low volatile, low ash, low sulphur

Smithing—1 1-4 in. screened

Fairmont — Quemahoning — Indiana County

NEW YORK OFFICE: 17 BATTERY PLACE

Branch Offices: Baltimore Buffalo Chicago Scranton, Pa. Mauch Chunk, Pa.

Stonehouse SIGNS, INC.

Stock and Special Signs, Codes, etc., for Mines

AKRON CLEVELAND CORRY, PA. COVINGTON, KY.

Bertha Coal

From Mines in Pennsylvania, Ohio, West Virginia and Kentucky

PRODUCED BY

Bertha-Consumers Company

General Offices
Chamber of Commerce Building
PITTSBURGH, PA.

Detroit Montreal New York Port Huron

Orvis C. Hoffman Leon H. Hoffman

DIAMOND CORE DRILLING
—CONTRACTORS—
HOFFMAN BROS.

PUNXSUTAWNEY, PA.
(Our Specialty—Testing Bituminous Coal Lands)
Up-To-Date Equipments. Expert Drill Runners. Inquiries Solicited

G.M. JOHNSON MFG. CO. Jeannette, Pa.

MANUFACTURERS OF

Mine Cages & Automatic Caging Devices.
Safety Horn Car Stops.
Chain Rail Car Hauls.
Automatic Gravity Feeders.
Automatic Switch Throwers.

PROOF

of the response to any thing new is to be found in the interest taken in it by those most concerned. The interest

of the

mining public in the new Practical Operating Men's Department is assured by the large number of letters that are coming in, attesting its

VALUE

JOHN BOYLE, JR.
Attorney-at-Law
Patents
B. S. IN MINING ENGINEERING AND METALLURGY. SIXTEEN YEARS IN THE EXAMINING CORPS OF THE UNITED STATES PATENT OFFICE.
OURAY BUILDING, WASHINGTON, D. C.

OFFICERS AND COMMITTEES, 1925—(Continued)

Thos. H. Edelblute, T. H. Edelblute Company, Wabash Bldg., Pittsburgh, Pa.
R. L. Gillispie, Asst. Supt., F. & S. Division, Bethlehem Steel Co., 322 Spruce St., Steelton, Pa.
Wm. F. Henke, Asst. Engr., Cincinnati Frog & Switch Co., Cincinnati, O.
F. C. Hohn, Engr., Pennsylvania Appraisal Co., 715 Traders Natl. Bank Bldg., Scranton, Pa.
F. W. Holcombe, American Frog and Switch Co., Hamilton, Ohio.
Wm. G. Hulbert, Genl. Supt., Wm. Wharton, Jr., & Co., Inc., Easton, Pa.
W. P. Jones, Supt., A. R. Mining Co., Chickasaw, Pa.
A. S. Karr, Sales Agent, Weir Frog Co., P. O. Box 1254, Pittsburgh, Pa.
Herman L. Koch, Mgr., Industrial Dept. Sweet's Steel Co., Williamsport, Pa.
F. J. McGrath, Genl. Supt., Sweet's Steel Co., Williamsport, Pa.
Charles C. Steel, Genl. Mgr. of Sales, Sweet's Steel Co., Williamsport, Pa.
Thomas H. Thompson, Mine Inspector, Kittanning, Pa.
J. R. Ulrich, Bethlehem Steel Co., Bethlehem, Pa.
H. N. West, Chf. Engr. and Works Mgr., Weir Frog. Co., Norwood, Ohio.
Arthur White, Supt. of Mines, Seminole, Pa.
John Woodall, Mine Supt., Conifer, Pa.

SUB-COMMITTEE NO. 3—MINE LOCOMOTIVES

Graham Bright (*Chairman*), Cons. Engr., Howard N. Eavenson & Associates, 1302 Union Trust Bldg., Pittsburgh, Pa.
Jos. Bryan, Salesman, General Electric Co., 535 Smithfield St., Pittsburgh, Pa.
Frederick C. Coseo, Chf. Draftsman, Jeffrey Mfg. Co., Columbus, Ohio.
Thos. F. Downing, Jr., The Edw. V. d'Invilliers Engr. Co., Central Bldg., Philadelphia, Pa.
A. H. Ehle, Mgr., Domestic Sales, Baldwin Locomotive Works, 500 N. Broad St., Philadelphia, Pa.
S. W. Farnham, Mng., Engr., Goodman Mfg. Co., 4834 S. Halstead St., Chicago, Ill.
W. J. Fene, Asst. Chf. Engr., Mine Safety Service, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh, Pa.
G. H. Shapter, Commercial Engr., Industrial Dept., General Electric Co., Erie, Pa.

Mining and Loading Equipment

D. J. Carroll, *Chairman*

SUB-COMMITTEE NO. 1—LOADERS

SECTION "A"—LOADING MACHINES AND METHODS OF LOADING

Frank E. Cash, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh, Pa.
G. W. Hay, Gen'l Mgr., Consolidation Coal Co., Jenkins, Ky.
T. E. Jenkins, Vice-Pres., West Kentucky Coal Co., Sturgis, Ky.
J. F. Joy, Pres., Joy Machine Co., Franklin, Pa.
N. D. Levin, Jeffrey Mfg. Co., Columbus, O.
N. H. McClevey, Vice-Pres. and Gen'l Mgr., Pike County Coal Corpn., Petersburg, Ind.
W. D. Turnbull, Genl. Engr. Dept., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
William Whaley, Gen'l Mgr., Myers-Whaley Co., Knoxville, Tenn.

SECTION "B"—IN THICK AND THIN COAL, WITH VARYING ROOF CONDITIONS

E. K. Bowers, Ass't Treas., Morgan-Gardner Elec. Co., 2640 Shields Ave., Chicago, Ill.
Frank E. Cash, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh, Pa.
S. W. Farnham, Mng. Engr., Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Walter Stevens, Supt., Raleigh-Wyoming Coal Co., Glen Rogers, W. Va.
F. W. Whiteside, Chf. Engr., Victor-American Fuel Co., Denver, Colo.

SUB-COMMITTEE NO. 2—CONVEYORS

Newell G. Alford, Mng. Engr., Union Trust Bldg., Pittsburgh, Pa.
E. H. Coxe, Gen'l Mgr., Snowdon Coke Co., Brownsville, Pa.
T. W. Dawson, Cons. Engr., H. C. Frick Coke Co., Scottdale, Pa.
Chas. Gottschalk, Cons. Engr., 920 Citizens Bank Bldg., Evansville, Indiana.
E. F. Miller, Gen'l Supt., Bertha-Consumers Coal Co., Rachel, W. Va.
G. B. Southward, Chief Engr., West Virginia Coal and Coke Co., Elkins, W. Va.
D. A. Stout, Mgr., Fuel Dept., Colorado Fuel and Iron Co., Pueblo, Colorado.
F. G. Wilcox, Pres., West End Coal Co., Scranton, Pa.
J. D. Zook, Vice-Pres., Illinois Coal Corpn., 37 Van Buren St., Chicago, Ill.

SUB-COMMITTEE NO. 3—CUTTING MACHINES

Carl Scholz (Chairman), Vice-Pres., Raleigh-Wyoming Coal Co., Charleston, W. Va.
Walter Calverley, Pres., Fayette Coal Corpn., Farmers Bank Bldg., Pittsburgh, Pa.
A. P. Cameron, Gen'l Mgr., Westmoreland Coal Co., Irwin, Pa.
J. M. Clark, Vice-Pres., Clark & Krebs, Inc., Charleston, W. Va.
H. P. Dyer, Gen'l Mgr., Vandalia Coal Co., Sullivan, Ind.
G. T. Haldeman, U. S. Bureau of Mines, Washington, D. C.
Wm. E. Hamilton, Mgr., Hamilton Engineering Co., 310 Schultz Bldg., Columbus, O.
E. S. McKinlay, Pres., McKinlay Mining and Loading Machine Co., Point Pleasant, W. Va.
M. Mitchell, Sullivan Machinery Co., St. Louis, Mo.

Mine Drainage

I. A. Malady, *Chairman*

SUB-COMMITTEE NO. 1—PUMPS FOR DEVELOPMENT WORK

L. W. Householder (*Chairman*), Chf. Engr., Rochester & Pittsburgh Coal & Iron Co., Indiana, Pa.
E. F. Austin, Dravo-Doyle Co., Pittsburgh, Pa.
Herbert Axford, Sales Engr., Ingersoll-Rand Co., 610 Spruce St., Scranton, Pa.
Harold P. Dyer, Genl. Mgr., Vandalia Coal Co., Sullivan, Ind.
J. H. Edwards, Associate Editor, Coal Age, 2962 Winters Rd., Huntington, W. Va.
F. J. Emeny, Vice Pres., The Deming Co., Salem, Ohio.
J. E. Holveck, Dist. Mgr., Aldrich Pump Co., 1209 Empire Bldg., Pittsburgh, Pa.
G. E. Huttle, Mech. Engr., H. C. Frick Coke Co., Scottdale, Pa.
Chas. H. Matthews, Genl. Engr. in Chg. Mining Section, Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
H. J. Nelms, Genl. Supt., New Field By-Products Coal Co., North Bessemer, Pa.
J. S. O'Flaherty, Chf. Engr., Central Coal & Coke Co., Keith & Perry Bldg., Kansas City, Mo.
F. W. Smith, Hydroelectric Pump & Supply Co., Curry Bldg., Pittsburgh, Pa.

SUB-COMMITTEE NO. 2—PERMANENT PUMPING STATIONS

Parker Cott (*Chairman*), Salesman, Coal Mine Equipment Co., 2218 Farmers Bank Bldg., Pittsburgh, Pa.
Herbert Axford, Sales Engr., Ingersoll-Rand Co., 610 Spruce St., Scranton, Pa.
Henry E. Cole, Vice Pres., Harris Pump & Supply Co., 320 Second Ave., Pittsburgh, Pa.
J. P. Heidenreich, Asst. Genl. Mgr., Scranton Pump Co., Scranton, Pa.
W. L. Robison, Vice Pres., Youghiogheny & Ohio Coal Co., 1230 Hanna Bldg., Cleveland, O.
R. F. Roth, Emmons Coal Mining Co., Altoona, Pa.
Cecil W. Smith, Chf. Engr., Illinois Coal Corpn., 1380 Old Colony Bldg., Chicago, Ill.
M. Spillman, Works Engr., Worthington Pump & Machinery Corpn., Harrison, N. J.
L. D. Tracy, Supt., U. S. Bureau of Mines, 312 Ceramics Bldg., Urbana, Ill.

SUB-COMMITTEE NO. 3—NATURAL DRAINAGE

John Brunschwyler (*Chairman*), Div. Supt., Boomer Coal & Coke Co., Boomer, W. Va.
M. C. Benedict, Cons. Engr., Brown Equipment Co., 940 Ash St., Johnstown, Pa.
Oscar Cartlidge, Cons. Engr., 1593 Lee St., Charleston, W. Va.
L. P. Crecelius, Engr., Cleveland & Western Coal Co., 1517 Union Trust Bldg., Cleveland, Ohio.
E. D. Knight, 2207 Washington St., Charleston, W. Va.
R. Y. Wert, Supt., Durham Coal & Iron Co., Soddy, Tenn.

SUB-COMMITTEE NO. 4—UNWATERING ABANDONED WORKINGS

Prof. John W. Hallock (*Chairman*), Head of Department of Industrial Engineering, University of Pittsburgh, Pittsburgh, Pa.
G. E. Huttle, Mech. Engr., H. C. Frick Coke Co., Scottdale, Pa.
J. A. Malady, Master Mech. & Elec. Engr., Hillman Coal & Coke Co., Pittsburgh, Pa.
O. M. Pruitt, Pres., Indiana Air Pump Co., Indiana Pythian Bldg., Indianapolis, Ind.
Chas. A. Straw, Cons. Mech. Engr., Hudson Coal Co., 434 Wyoming Ave., Scranton, Pa.
G. V. Woody, Mgr., Allis-Chalmers Mfg. Co., Wilkes-Barre, Pa.

SUB-COMMITTEE NO. 5—MINE WATER AND ITS ACTION UPON MINE DRAINAGE EQUIPMENT

Geo. A. Drysdale (*Chairman*), Metallurgical Elitor, Foundry, Penton Publishing Co., Cleveland, Ohio.
M. L. Bettcher, Production Engr., The Duriron Co., Inc., Dayton, Ohio.
J. R. Campbell, Hudson Coal Co., Scranton, Pa.
Geo. Watkin Evans, Cons. Coal Mng. Engr., L. C. Smith Bldg., Seattle, Wash.
Carl J. Fletcher, Vice Pres., Knox Coal Mng. Co., Merchants Bank Bldg., Indianapolis, Ind.
C. L. Harrod, Elec. Engr., Indiana Coal Oprs. Power Assn., 1509 Merchants Bank Bldg., Indianapolis, Ind.
Martin J. Lide, Cons. Engr., Woodward Bldg., Birmingham, Ala.
Frank G. Morris, Genl. Supt. of Mines, Republic Iron & Steel Co., Sayreton, Ala.
J. S. O'Flaherty, Chf. Engr., Central Coal & Coke Co., Keith & Perry Bldg., Kansas City, Mo.
L. D. Rover, Power & Construction Dept., Ford Motor Co., Detroit, Mich.
W. H. Waddington, Sales Engr., Driver-Harris Co., Harrison, N. J.

Mine Ventilation

C. H. Trik, *Chairman*

SUB-COMMITTEE NO. 1—AIR SHAFTS AND AIR WAYS

J. C. Gaskill (*Chairman*), Asst. Cons. Engr., Consolidation Coal Co., Fairmont, W. Va.
C. H. Beidenmiller, Mgr., Glogora Coal Co., 705 First Natl. Bank Bldg., Huntington, W. Va.
J. H. Doughty, Mech. Engr., Lehigh & Wilkes-Barre Coal Co., 16 So. River St., Wilkes-Barre, Pa.
Robert Wallace, Supt., Pocahontas Fuel Co., Inc., Pocahontas, Va.
Jos. J. Walsh, Secretary of Mines, Pennsylvania Dept. of Mines, Harrisburg, Pa.

SUB-COMMITTEE NO. 2—MINE FAN INSTALLATION

G. E. Lyman (*Chairman*), Genl. Supt., Madison Coal Corpn., Glen Carbon, Ill.
H. G. Conrad, Genl. Mgr., American Coal Mining Co., Bicknell, Ind.
R. B. Fleming, Evansburg Coal Co., Colver, Pa.
E. B. Wagner, Lehigh Valley Coal Co., Wilkes-Barre, Pa.

SUB-COMMITTEE NO. 3—BOOSTER FANS

R. Dawson Hall (*Chairman*), Engineering Editor, Coal Age, 10th Ave. at 36th St., New York City.
Howard N. Eavenson, Pres., Howard N. Eavenson & Associates, 1302 Union Trust Bldg., Pittsburgh, Pa.
R. H. Moore, Genl. Mgr., C. A. Hughes & Co., Portage, Pa.
E. N. Zern, Editor, Mining Catalog, Keystone Cons. Publishing Co., 800 Penn Ave., Pittsburgh, Pa.

SUB-COMMITTEE NO. 4—MINE ATMOSPHERE

Thomas Chester (*Chairman*), Cons. Engr., 2970 W. Grand Blvd., Detroit, Mich.
Martin J. Lide, Cons. Engr., Woodward Bldg., Birmingham, Ala.
R. M. Perry, Genl. Supt., Moffat Coal Co., 504 Gas & Elec. Bldg., Denver, Colo.

Outside Coal Handling Equipment

James Needham, *Chairman*

Hubb Bell, Sales Chemist, C. P. Chemical & Drug Co., Inc., 114 Liberty St., New York City.
J. W. Bischoff, Vice Pres. & Genl. Mgr., West Virginia Coal & Coke Co., Elkins, W. Va.
W. G. Duncan, Jr., Supt., W. G. Duncan Coal Co., Greenville, Ky.
H. H. Elkins, Supt. of Mines, Valley Camp Coal Co., St. Clairsville, Ohio.
M. A. Kendall, Chf. Engr., Stephens-Adamson Mfg. Co., Aurora, Ill.
Rudolf Kudlich, Asst. to Chf. Mech. Engr., U. S. Bureau of Mines, Washington, D. C.
John J. Moore, Dey & Maddock, 82d and Dennison Sts., Cleveland, Ohio.
F. G. Morris, Genl. Supt. of Coal Mines, Republic Iron & Steel Co., Sayreton, Ala.
G. H. Morse, Genl. Supt., Republic Iron & Steel Co., Oliver Bldg., Pittsburgh, Pa.
H. F. Nash, Vice Pres. & Genl. Mgr. of Sales, Oakdale Coal Co., Gas and Electric Bldg., Denver, Colo.
Warren R. Roberts, Pres., Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.
H. D. Smith, Genl. Supt., American Coal Co. of Allegany County, McComas, W. Va.
C. K. Stahl, Asst. to Genl. Mgr., E. E. White Coal Co., Stotesburg, W. Va.
C. Law Watkins, Vice Pres., Pennsylvania Coal & Coke Corpn., Cresson, Pa.
F. W. Whiteside, Chf. Engr., Victor-American Fuel Co., Ernest & Cranmer Bldg., Denver, Colo.

Underground Power Transmission

A. B. Kiser, *Chairman*

W. A. Chandler, Elec. Engr., Hudson Coal Co., Scranton, Pa.
Harvey Conrad, Genl. Mgr., American Coal Mng. Co., Bicknell, Ind.
L. C. Ilsley, U. S. Bureau of Mines, 4800 Forbes St., Pittsburgh, Pa.
R. L. Kingsland, Genl. Supt., Power and Mechanical Dept., Consolidation Coal Co., Fairmont, W. Va.
Carl Lee, Elec. Engr., Peabody Coal Co., 1652 McCormick Bldg., Chicago, Ill.
Wm. Schott, Cons. Engr., Big Creek Coal Co., Chicago, Ill.
Henry M. Warren, Cons. Engr., Glen Alden Coal Co., 300 Jefferson Ave., Scranton, Pa.

Power Equipment

F. L. Stone, *Chairman*

W. C. Adams, Allen & Garcia, Chicago, Ill.
Graham Bright, Cons. Engr., Howard N. Eavenson & Associates, 1302 Union Trust Bldg., Pittsburgh, Pa.

Satisfied Customers

Admiralty Coal
New River Smokeless

If you have never used a General Coal, backed by General Coal Company's dependable service, you cannot appreciate the fact that it does make a difference where you get your fuel.

Eighty-five percent of our customers are "Old Timers" who return year after year knowing that they are buying increased power at decreased cost.

After all, the principal attribute of any business is satisfied customers. Your first order will result in a new name added to our long list of "regulars."

We will gladly furnish you with more information upon request.

DEPENDABLE COAL
Anthracite

GENERAL COAL COMPANY

1727 Land Title Building
PHILADELPHIA

BUNKER COAL
Supplied at
Baltimore, Md.
Charleston, S. C.
Hampton Roads, Va.
Jacksonville, Fla.
New York
Philadelphia
Savannah, Ga.

BOSTON
CHARLESTON
CHARLOTTE
CINCINNATI

EXCLUSIVE SALES AGENT
—FOR—
STONEGA COKE AND COAL CO.
HAZLE BROOK COAL CO.
—AND—
SUCCESSOR TO BUSINESS OF
WENTZ COMPANY
—ALSO—
EXCLUSIVE WESTERN SALES AGENT
—FOR—
WESTMORELAND COAL CO.

DETROIT
NEW YORK
NORFOLK
PITTSBURGH

EXPORT & COASTWISE COAL
Loaded at
Baltimore, Md.
Charleston, S. C.
Hampton Roads, Va.
Philadelphia

THE LEHIGH COAL AND NAVIGATION COMPANY

Miners and Shippers

OLD COMPANY'S LEHIGH

For Over a Century

1820 ANTHRACITE 1925

"The Best Since 1820"

437 CHESTNUT STREET - PHILADELPHIA, PENNSYLVANIA

OFFICERS AND COMMITTEES, 1925—(Continued)

Stephen H. Green, Pacific Coast Coal Co., Seattle, Wash.
O. P. Hood, Chf. Mech. Engr., U. S. Bureau of Mines, Washington, D. C.
J. T. Jennings, Power Engr., Philadelphia & Reading Coal & Iron Co., Pottsville, Pa.
R. L. Kingsland, Consolidation Coal Co., Fairmont, W. Va.
M. D. Kirk, Vesta Coal Co., Jones & Laughlin Bldg., Pittsburgh, Pa.
Chas. Legrand, Cons. Engr., Phelps Dodge Corpn., Douglas, Ariz.
Martin J. Lide, Cons. Engr., Woodward Bldg., Birmingham, Ala.
D. C. McKeehan, Chf. Elec., Union Pacific Coal Co., Rock Springs, Wyo.
J. A. Malady, Master Mech. & Elec. Engr., Hillman Coal & Coke Co., 2307 First National Bank Bldg., Pittsburgh, Pa.
A. J. Nicht, Jr., Engr., Hoisting Equipment, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
W. C. Shunk, Stonega Coal & Coke Co., Big Stone Gap, Va.
Geo. S. Thompson, Chf. Elec. & Master Mech., Colorado Fuel & Iron Co., Pueblo, Colo.
C. D. Woodward, Chf. Elec. Engr., Anaconda Copper Mining Co., 514 Hennessy Bldg., Butte, Mont.

Mine Timbering

R. L. Adams, *Chairman*

SUB-COMMITTEE NO. 1—GENERAL MINE TIMBERING, SIMPLIFICATION ON GRADES AND NAMES

J. R. Sharp (Chairman), care of C. F. Kurtz Co., Rock Island, Ill.
Newell G. Alford, Vice Pres., Howard N. Eavenson & Associates, 1302 Union Trust Bldg., Pittsburgh, Pa.
R. W. Austin, Austin & Wood, North 3rd St., Clearfield, Pa.
J. R. Crowe, Jr., Pres., Crowe Coal Co., Dwight Bldg., Kansas City, Mo.
D. F. Holtman, Construction Engr., National Lumber Mfgrs. Assn., 402 Transportation Bldg., Washington, D. C.
G. A. Knox, Supt., Gunn-Quealey Coal Co., Quealy, Wyoming.
Ernest M. Merrill, Pres., Merrill-Ferguson Engineering Co., 506 Kanawha Bank & Trust Bldg., Charleston, W. Va.
Chas. N. Perrin, Chairman, Rules Committee, National Hardwood Lumber Assn., Bank of Wisconsin Bldg., Madison, Wis.
George S. Rice, Chf. Mng. Engr., U. S. Bureau of Mines, Washington, D. C.
Geo. T. Stevens, Chf. Engr., Clinchfield Coal Corpn., Dante, Va.

SUB-COMMITTEE NO. 2—PRESERVATION OF MINE TIMBERS

Geo. M. Hunt (*Chairman*), In Charge of Wood Preservation Section, Forest Products Laboratory, Madison, Wis.
W. L. Affelder, Asst. to Pres., Hillman Coal and Coke Co., 2306 First Natl. Bank Bldg., Pittsburgh, Pa.
R. W. Austin, Austin & Wood, North 3rd St., Clearfield, Pa.
M. H. Sellers, Chicago, Wilmington & Franklin Coal Co., Carbondale, Ill.
D. A. Stout, Mgr., Fuel Dept., Colorado Fuel & Iron Co., Pueblo, Colo.

SUB-COMMITTEE NO. 3—USE OF CONCRETE IN MINE TIMBERING

Newell G. Alford (*Chairman*), Vice-Pres., Howard N. Eavenson & Associates, 1302 Union Trust Bldg., Pittsburgh, Pa.
B. C. Collier, Pres., Cement-Gun Co., Inc., Allentown, Pa.
W. R. Peck, Chf. Engr., Black Diamond Collieries, Coal Creek, Tenn.
H. S. Wright, Engr., Structural Bureau, Portland Cement Assn., 111 W. Washington St., Chicago, Ill.

SUB-COMMITTEE NO. 4—USE OF STRUCTURAL STEEL FOR MINE TIMBERING

(Personnel not appointed.)

SUB-COMMITTEE NO. 5—SALVAGE OF MINE TIMBERS

George T. Stevens (*Chairman*), Chf. Engr., Clinchfield Coal Corpn., Dante, Va.

METAL MINING BRANCH

General Committee

Charles A. Mitke (*Chairman*), Cons. Mng. Engr., Phoenix, Ariz.
Frank Ayer, Mgr., Moctezuma Copper Co., Nacozari, Sonora, Mexico.
Wm. Conibear, Safety Inspector, Cleveland-Cliffs Iron Co., Ishpeming, Mich.
Arthur Crowfoot, Mill Supt., Phelps Dodge Corpn., Morenci, Ariz.
William B. Daly, Genl. Mgr. of Mines, Anaconda Copper Mining Co., 504 Hennessy Bldg., Butte, Mont.
Lucien Eaton, Supt., Ishpeming District, Cleveland-Cliffs Iron Co., Ishpeming, Mich.
Wm. H. Gallagher, Jr., Chf. Mng. Engr., Pickands-Mather & Co., 700 Sellwood Bldg., Duluth, Minn.
H. C. Goodrich, Chf. Engr., Utah Copper Co., Kearns Bldg., Salt Lake City, Utah.
T. O. McGrath, Asst. Mgr., Shattuck-Arizona Copper Co., Bisbee, Ariz.
Dr. Frank H. Probert, Dean, College of Mining, University of California, Berkeley, Calif.
Philip D. Wilson, Chief Geologist, Calumet & Arizona Mining Co., Warren, Ariz.

Mine Drainage

Wm. H. Gallagher, Jr., *Chairman*

H. T. Abrams, Dept. Mgr. of Air Lift Pumps and "Calyx" Drills, Ingersoll-Rand Co., 11 Broadway, New York City.
G. L. Kollberg, Mgr., Pumping Engine Dept., Allis-Chalmers Mfg. Co., Milwaukee, Wis.
O. D. McClure, Chief Mech. Engr., Cleveland-Cliffs Iron Co., Ishpeming, Mich.
Charles Mendelsohn, Master Mechanic, Old Dominion Company, Globe, Ariz.
W. A. Rankin, Elec. Engr., Copper Range Company, Painesdale, Mich.
W. N. Tanner, Chief Engr., Anaconda Copper Mining Co., 514 Hennessy Bldg., Butte, Mont.
C. D. Woodward, Chief Elec. Engr., Anaconda Copper Mining Co., 514 Hennessy Bldg., Butte, Mont.

Drilling Machines and Drill Steel

Frank Ayer, *Chairman*

SUB-COMMITTEE NO. 1—DRILLING MACHINES

B. F. Tillson (*Chairman*), Asst. Supt., New Jersey Zinc Co., Franklin, N. J.
L. C. Bayles, Designing Engr., Rock Drill Dept., Ingersoll-Rand Co., Phillipsburg, N. J.
Arthur B. Foote, Genl. Mgr., North Star Mines Co., Grass Valley, California.
J. A. Fulton, Idaho-Maryland Mines Co., Grass Valley, California.
Roy H. Marks, Efficiency Engr., United Verde Extension Mng. Co., Jerome, Arizona.
R. T. Murrill, Efficiency Engr., St. Joseph Lead Co., Rivermines, Mo.
R. A. Scott, Sales Mgr., Denver Rock Drill Mfg. Co., 39th and Williams St., Denver, Colo.
W. C. Scott, Supt., Morenci Branch, Phelps Dodge Corpn., Metcalf, Ariz.
George A. Shaw, Mine Supt., Talache Mines, Inc., Talache, Idaho.
H. T. Walsh, Vice Pres., Sullivan Machinery Co., Peoples Gas Bldg., Chicago, Ill.

SUB-COMMITTEE NO. 2—DRILL STEEL

Norman B. Braly, Genl. Mgr., North Butte Mng. Co., Butte, Mont.
E. G. Deane, Mgr., Superior & Boston Copper Co., Copper Hill, Ariz.
O. J. Egleston, Mgr., U. S. Smelting, Refining & Mining Co., Kennett, Calif.
C. S. Elayer, Cloudcroft, New Mexico.
E. F. Hastings, Salesman, Ingersoll-Rand Co. of Texas, Dominion Hotel, Globe, Ariz.
Chas. S. Hurter, Tech. Representative, E. I. du Pont de Nemours & Co., Inc., 5104 Du Pont Bldg., Wilmington, Del.
Charles B. Officer, Asst. to Pres., Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.
Henry S. Potter, Managing Director, Henry S. Potter, Ltd., 26 Cullinan Bldg., Johannesburg, South Africa.
Ocha Potter, Supt., Ahmeek-Kearsarge Br., Calumet & Hecla Mng. Co., Ahmeek, Mich.
Chas. A. Smith, Asst. Genl. Mgr., Ray Consolidated Copper Co., Ray, Ariz.
A. S. Uhler, Mgr., Rock Drill Sales, Ingersoll-Rand Co., 11 Broadway, New York City.
M. van Sicklen, Engr., In Charge of Mining Research, U. S. Bureau of Mines, Washington, D. C.
Bruce C. Yates, Supt., Homestake Mining Co., Lead, South Dakota.

SUB-COMMITTEE NO. 3—METHODS OF SHARPENING DRILL STEEL

George H. Gilman, Pres., Gilman Mfg. Co., E. Boston, Mass.
Chas. E. Lees, Supt., Iron Cap Copper Co., Copper Hill, Ariz.
Frank W. McLean, United Verde Copper Co., Jerome, Ariz.
Arthur Notman, Cons. Engr., 170 Broadway, New York City.
W. H. Schacht, Genl. Mgr., Copper Range Co., Painesdale, Mich.
H. W. Seamon, Supt., Comstock Merger Mines, Inc., Virginia City, Nevada.
W. R. Wade, 1230 Geary St., San Francisco, Calif.

Underground Transportation

William B. Daly, *Chairman*

Thos. C. Baker, Genl. Mgr., The Comstock Merger Mines Co., Virginia City, Nevada.
George H. Booth, Mech. Engr., Inspiration Cons. Co., Inspiration, Arizona.
R. R. Boyd, Asst. Supt., Mine Dept., Copper Queen Branch, Phelps Dodge Corpn., Bisbee, Arizona.
D. S. Calland, Managing Director, Compania de Real del Monte de Pachuca, Pachuca, Hidalgo, Mexico.
W. R. Crane, Supt., Southern Station, U. S. Bureau of Mines, New Federal Bldg., Birmingham, Alabama.
W. Val DeCamp, Genl. Mine Supt., United Verde Copper Co., Jerome, Arizona.
Robert H. Dickson, Supt., 85 Branch, Calumet & Arizona Mining Co., Valedon, New Mexico.
Stanly A. Easten, Mgr., Bunker Hill & Sullivan Mng. & Concentrating Co., Kellogg, Idaho.
H. T. Hamilton, Cons. Mng. Engr., 1408 California Commercial Union Bldg., San Francisco, California.
F. H. Hayes, Mine Supt., Copper Queen Branch, Phelps Dodge Corpn., Bisbee, Arizona.
R. E. Howe, Genl. Supt., Cananea Cons. Copper Co., Cananea, Sonora, Mexico.
John Kiddie, Mine Supt., Phelps Dodge Corpn., Morenci, Arizona.
C. A. Lantz, Genl. Mgr., Compania de Santa Gertrudis, S. A., Apartado No. 1, Pachuca, Hidalgo, Mexico.
E. M. Norris, Asst. Genl. Supt. of Mines, Anaconda Copper Mining Co., Butte, Mont.
Thomas K. Scott, Supt., Munro Iron Mining Co., Iron River, Mich.
Andover Syverson, Prescott, Arizona.

Fire-Fighting Equipment

Wm. Conibear, *Chairman*

SUB-COMMITTEE NO. 1—CONTROL OF VENTILATING EQUIPMENT DURING MINE FIRES

Orr Woodburn (*Chairman*), Safety Engr., Globe-Miami District, Globe, Ariz.
Guy J. Johnson, Mgr., Golden Gate Mine and Timber Co., Atlantic City, Wyo.
H. J. Rahilly, Supt., Mine Fire and Hydraulic Filling Dept., Anaconda Copper Mining Co., Butte, Mont.
Albert Fallon, Safety Inspector, The Old Dominion Co., Globe, Ariz.
J. T. Young, Safety Inspector, Arizona Copper Company, Morenci, Ariz.

SUB-COMMITTEE NO. 2—FIRE HOSE

R. H. Seip (*Chairman*), New Jersey Zinc Co., Franklin, N. J.
C. W. Moon, Safety Inspector, Phelps Dodge Corpn., Bisbee, Ariz.
B. O. Pickard, District Engineer, U. S. Bureau of Mines, Berkeley, Calif.

Mining Excavating Equipment—Exclusive of Dredges

H. C. Goodrich, *Chairman*

H. G. S. Anderson, Mng. and Met. Engr., Rolla, Mo.
H. C. Bellinger, Vice Pres., Chile Exploration Co., 25 Broadway, New York City.
Michael Curley, Genl. Supt., New Cornelia Copper Co., Ajo, Ariz.
H. T. Gracely, Adv. Mgr., Marion Steam Shovel Co., Marion, Ohio.
C. B. Lakenan, Genl. Mgr., Nevada Cons. Copper Co., McGill, Nev.
W. J. Lester, Pres., Kentucky Washed Coal Co., Greenville, Ky.
Geo. Mieyr, Supt., Sacramento Hill, Copper Queen Branch, Phelps Dodge Corpn., Bisbee, Ariz.
G. A. Murfey, Treas. and Chief Engr., The Browning Co., 16226 Waterloo Rd., Cleveland, Ohio.
Henry B. Oatley, Vice Pres., Superheater Co., 17 E. 42nd St., New York City.
Thos. A. Snyder, Bucyrus Co., South Milwaukee, Wis.
Robt. E. Tally, Genl. Mgr., United Verde Copper Co., Jerome, Ariz.
J. C. Wheat, Development Engr., Industrial Works, Bay City, Mich.
Charles S. Whitaker, Vice Pres., Winston Bros. Co., 801 Globe Bldg., Minneapolis, Minn.

Mine Ventilation

Chas. A. Mitke, *Chairman* (*Temporary*)

Robt. N. Bell, Cons. Mng. Engr., Box 1339, Boise, Idaho.
Walter C. Browning, Genl. Mgr., Magma Copper Co., Superior, Ariz.
O. K. Dyer, Mgr., Small Blower Dept., Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Daniel Harrington, 507 Newhouse Bldg., Salt Lake City, Utah.
E. T. Lednum, Mgr., E. I. du Pont de Nemours & Co., Inc., 406 Ideal Bldg., Denver, Colo.
C. E. Legrand, Cons. Engr., Phelps Dodge Corpn., Douglas, Ariz.
F. W. Maclennan, Genl. Mgr., Miami Copper Co., Miami, Ariz.
Don M. Rait, Asst. Supt. of Mines, Calumet and Arizona Mining Co., Warren, Ariz.
A. S. Richardson, Ventilation Engr., Anaconda Copper Mining Co., Butte, Mont.
Wm. A. Rowe, Chief Engr., American Blower Co., 6004 Russell St., Detroit, Mich.
A. C. Stoddard, Chief Mine Engr., Inspiration Cons. Copper Co., Inspiration, Ariz.
F. L. Stone, Industrial Engineering Dept., General Electric Co., Schenectady, N. Y.
E. B. Williams, Mgr., Marine Dept., B. F. Sturtevant Co., Hyde Park, Boston, Mass.

Mechanical Loading Underground

Lucien Eaton, *Chairman*

SUB-COMMITTEE NO. 1—LOADING MACHINES FOR TUNNELS, LARGE DRIFTS AND STOPES

Douglas C. Corner (*Chairman*), Mng. Engr., 1004 Federal Reserve Bank Bldg., St. Louis, Mo.
H. E. Billington, Vice Pres. for Sales, The Thew Shovel Co., Lorain, Ohio.
J. H. Hensley, Mine Supt., Miami Copper Co Miami, Ariz.
H. DeWitt Smith, New York Trust Co., 10 Broadway, New York City.

TYRONE, NEW MEXICO, presents an outstanding example of the results that follow the building-up of community spirit in mining camps. The largest photograph gives a view of the Plaza at Tyrone during the celebration of 4th of July. At the top is a more general view of the Plaza; below, the schoolhouse is shown.

The Old Order Changes

CIVIC PRIDE is a great asset to any community, any state, any nation. All of us are intrigued with the idea that we have even in a small way contributed something to the betterment of our community.

The new order of things in the mining industry is inspirational—gone are the monotonous rows of identical houses; gone is the shiftless half-hearted effort merely to keep the weeds down. Into both management and worker is being instilled the pride of creation—the desire for individuality—the little seed of civic pride.

Mining companies are anxious that their employes shall be contented, but what is more encouraging is that the miners and their children are themselves anxious to take advantage of the opportunities offered them.

In the remote mining fields of New Mexico and Arizona the miner's child has the same opportunity for self development as the child in the nation's capital. Some of the finest high schools in the country will be found in mining districts.

Capital and labor are daily—if slowly—learning the big lesson of interdependence, of mutual responsibility, and

INDUSTRIAL COOPERATION

OFFICERS AND COMMITTEES, 1925—(Concluded)

H. G. Washburn, Mng. Engr., American Smelting & Refining Co., McCormick Bldg., Salt Lake City, Utah.
Mr. William Whaley, Genl. Mgr., Myers-Whaley Co., Knoxville, Tenn.

SUB-COMMITTEE NO. 2—LOADING MACHINES FOR SMALL DRIFTS AND FOR WORK ON SUB-LEVELS

G. R. Jackson (*Chairman*), Supt., Cleveland-Cliffs Iron Co., Negaunee, Mich.
C. L. Berrien, Genl. Supt. of Mines, Anaconda Copper Mining Co., Butte, Mont.
H. H. Talboys, Mgr., Shuveloder Dept., Nordberg Mfg. Co., Milwaukee, Wis.
Chas. E. Van Barneveld, U. S. Bureau of Mines, Mississippi Valley Experiment Station, St. Louis, Mo.

SUB-COMMITTEE NO. 3—SCRAPERS

Lucien Eaton (*Chairman*), Supt., Ishpeming District, Cleveland-Cliffs Iron Co., Ishpeming, Mich.
C. L. Kohlhass, Denver Rock Drill Co., Duluth, Minn.
Ward Royce, Ingersoll-Rand Co., Houghton, Mich.
E. E. Whiteley, Supt. of Mines, Calumet & Arizona Mining Co., Warren, Ariz.

Mine Timbering

Frank H. Probert, *Chairman*

SUB-COMMITTEE NO. 1—PRESERVATION OF MINE TIMBERS

Geo. M. Hunt (*Chairman*), In Charge of Section of Wood Preservation, Forest Products Laboratory, Madison, Wis.
Gerald Sherman, Cons. Mng. Engr., Phelps Dodge Corpn., Douglas, Ariz.

SUB-COMMITTEE NO. 2—GUNITE AS A SUBSTITUTE FOR TIMBER, ITS PROPER APPLICATIONS AND ITS LIMITATIONS

E. M. Norris (*Chairman*), Asst. Genl. Supt. of Mines, Anaconda Copper Mining Co., Butte, Mont.
B. C. Collier, Pres., Cement-Gun Co., Inc., Allentown, Pa.
R. R. Horner, Cons. Engr., U. S. Bureau of Mines, Clarksburg, W. Va.

SUB-COMMITTEE NO. 3—DETERMINATION OF SIZE AND SHAPE OF DRIFTS AND DRIFT TIMBERS FOR VARIOUS PURPOSES, WITH A VIEW TO REDUCING SAME TO CERTAIN STANDARD SIZES AND SHAPES

Dr. F. W. Sperr (*Chairman*), Professor of Civil and Mining Engineering, Michigan College of Mines, 315 Florence St., Houghton, Mich.
C. L. Berrien, Genl. Supt. of Mines, Anaconda Copper Mining Co., Butte, Mont.
Felix McDonald, Mines Supt., Inspiration Cons. Copper Co., Inspiration, Ariz.

SUB-COMMITTEE NO. 4—COOPERATION BETWEEN OPERATORS AND LUMBER DEALERS AND MANUFACTURES, WITH A VIEW TO ASCERTAINING WHETHER FURTHER STANDARDIZATION IN SIZES AND SHAPES OF LUMBER UNDERGROUND WOULD RESULT IN A REDUCTION IN COST TO MINING COMPANIES

Charles F. Willis (*Chairman*), Editor and Publisher, Arizona Mining Journal, Phoenix, Ariz.
W. S. Boyd, Genl. Mgr., Ray Cons. Copper Co., Ray, Ariz.
T. Evans, Genl. Mgr., Cananea Cons. Copper Co., Cananea, Sonora, Mexico.
D. F. Holtman, Construction Engr., National Lumber Manufacturers Association, 402 Transportation Bldg., Washington, D. C.
G. R. Jackson, Supt., Negaunee Mine, Cleveland-Cliffs Iron Co., Negaunee, Mich.
John Kiddie, Mine Supt., Phelps-Dodge Corpn., Morenci, Ariz.
W. G. McBride, Genl. Mgr., Old Dominion Co., Globe, Ariz.

Mine Accounting

T. O. McGrath, *Chairman*

L. S. Cates, Vice-Pres. and Genl. Mgr., Utah Copper Co., Salt Lake City, Utah.
J. C. Dick, Mng. Engr., 511 Newhouse Bldg., Salt Lake City, Utah.
L. K. Diffenderfer, Secy. and Treas., Vanadium Corporation of America, 120 Broadway, New York City.
H. B. Fernald, Loomis-Suffern & Fernald, 50 Broad St., New York City.
H. H. Miller, General Auditor, Hercules Mining Company, Wallace, Idaho.
H. L. Norton, Phelps-Dodge Corpn., Douglas, Ariz.
Harry Vivian, Chief Engr., Calumet & Hecla Cons. Copper Co., Calumet, Mich.
Geo. Young, Secy. and Treas., Cananea Cons. Copper Co., Cananea, Sonora, Mexico.

Milling and Smelting Practices and Equipment

Arthur Crowfoot, *Chairman*

SUB-COMMITTEE NO. 1—MILLING PRACTICES AND EQUIPMENT

Arthur Crowfoot (Chairman), Mill Supt., Phelps-Dodge Corpn., Morenci, Ariz.
H. G. S. Anderson, Rolla, Mo.
Herman C. Bellinger, Vice-Pres., Chile Exploration Co., 25 Broadway, New York City.
Allan J. Clark, Supt. of Mills, Homestake Mining Co., Lead, S. Dak.
G. R. Delamater, Fuel Engr., W. S. Tyler Co., Superior St., Cleveland, Ohio.
W. M. Drury, Genl. Mgr., Mining Dept., American Smelting and Refining Co., El Paso, Tex.
Guy H. Ruggles, Mill Supt., Inspiration Cons. Copper Co., Inspiration, Ariz.
Henry A. Tobelmann, Cons. Engr. and Chemist, Associated Industries, 21 E. 40th St., New York City.
William Young Westervelt, Cons. Mng. Engr., 522 Fifth Ave., New York City.

SUB-COMMITTEE NO. 2—SMELTING PRACTICES AND EQUIPMENT

J. Owen Ambler, Smelter Supt., Phelps-Dodge Corpn., Clifton, Ariz.
P. P. Butler, Supt. of Douglas Reduction Works, Phelps-Dodge Corpn., Douglas, Ariz.
Harry A. Clark, Smelter Supt., Calumet and Arizona Mining Co., Douglas, Ariz.
Kuno Doerr, Genl. Mgr., Southwestern Dept., American Smelting & Refining Co., El Paso, Tex.
F. L. Flynn, Toltec Club, El Paso, Tex.
Professor Carle R. Hayward, Associate Professor of Metallurgy, Mass. Institute of Technology, Cambridge, Mass.
George W. Prince, Asst. Genl. Mgr., United Verde Extension Mining Co., Clemenceau, Ariz.
Forest Rutherford, Cons. Metallurgical Engr., 50 Broad St., New York City.

Methods of Mine Sampling, Methods of Recording Underground Geological Data, and Methods of Estimation of Ore Reserves For Low Medium and High Grade Ore bodies

Philip D. Wilson, *Chairman*

Guy Bjorge, Cons. Mng. Geologist, 788 Mills Bldg., San Francisco, Calif.
E. L. Derby, Jr., Chief Geologist, Cleveland-Cliffs Iron Co., Ishpeming, Mich.
M. J. Elsing, Mng. Engr. and Geologist, Warren, Ariz.
Dr. L. C. Graton, Professor of Geology, Harvard University, Cambridge, Mass.
Julius Kruttschnitt, Jr., Mgr., Mining Dept. of the Southwest, American Smelting and Refining Co., Tucson, Ariz.
F. A. Linforth, Asst. Chf. Geologist and Asst. Chf. Mng. Engr., Anaconda Copper Mining Co., 526 Hennessy Bldg., Butte, Mont.
Albert Mendelsohn, Underground Supt., Champion Copper Co., Painesdale, Mich.
MacHenry Mosier, Asst. Mine Supt., Morenci Branch, Phelps-Dodge Corpn., Morenci, Ariz.
Louis E. Reber, Jr., Chf. Geologist, United Verde Copper Co., Jerome, Ariz.
T. Skewes Saunders, Cons. Mng. Engr., La Mutua 525, Av. Cinco De Mayo No. 2, Mexico, D. F.
J. B. Tenney, Geologist, Copper Queen Branch, Phelps-Dodge Corpn., Bisbee, Ariz.
Robert W. Thomas, Supt. of Mines, Ray Cons. Copper Co., Ray, Ariz.

Joint Publicity Committee

Representing Coal Mining Branch:

Ralph C. Becker, Vice-Pres., Keystone Consolidated Publishing Company, 800 Penn Ave., Pittsburgh, Pa.
C. H. Trik, Sales and Mine Ventilation Engr., Jeffrey Mfg. Co., Columbus, Ohio.

Representing Metal Mining Branch:

T. O. McGrath, Asst. Mgr., Shattuck-Arizona Copper Co., Bisbee, Ariz.
Charles F. Willis, Editor and Publisher, Arizona Mining Journal, Phoenix, Ariz.

COMMITTEES

COOPERATION

AMERICAN MINING CONGRESS AND AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

A. M. C.

A. Cressy Morrison, 30 E. 42nd St., New York City.
J. E. Spurr, Hill Bldg., New York City.
W. R. Ingalls, 115 Broadway, New York City.
J. R. Finlay, 170 Broadway, New York City.
Daniel B. Wentz, Land Title Bldg., Philadelphia, Pa.

A. I. M. & M. E.

E. P. Mathewson, 42 Broadway, New York City.
W. L. Saunders, 11 Broadway, New York City.
Walter Douglas, 99 John St., New York City.
Benjamin B. Thayer, 25 Broadway, New York City.
Samuel Taylor, Second National Bank Bldg., Pittsburgh, Pa.

ALASKAN AFFAIRS

John A. Davis, U. S. Bureau of Mines, Washington, D. C.
Falcon Joslin, 2203 L. C. Smith Bldg., Seattle, Wash.
Bart L. Thane, 408 Crocker Bldg., San Francisco, Calif.

MINING IN FOREIGN COUNTRIES

J. E. Spurr, *Chairman*, Hill Bldg., New York City.
Van H. Manning, 15 West 44th St., New York City.
E. L. Doheny, 120 Broadway, New York City.
W. J. Loring, Merchants National Bank Bldg., Los Angeles, Calif.
Matthew C. Fleming, New York City.
H. Foster Bain, 29 W. 39th St., New York City.

ADVISORY COMMITTEE UNITED STATES BUREAU OF MINES AND GEOLOGICAL SURVEY

Bulkeley Wells, *Chairman*, San Francisco, Calif.
Walter Douglas, New York City.
Rembrandt Peale, New York City.
H. Foster Bain, 29 W. 39th St., New York City.
George Otis Smith, U. S. Geological Survey, Washington, D. C.

DEPARTMENT OF MINES AND MINING

W. J. Loring, *Chairman*, San Francisco, Calif.
Walter Douglas, New York City.
Bulkeley Wells, San Francisco, Calif.
George H. Crosby, Duluth, Minn.
D. C. Jackling, Hobart Bldg., San Francisco, Calif.
Carl Scholz, Charleston, W. Va.
S. D. Warriner, Philadelphia, Pa.

COOPERATION INTERNAL REVENUE DEPARTMENT

J. F. Callbreath, American Mining Congress, Munsey Bldg., Washington, D. C.
John T. Barnett, 1024 Lafayette St., Denver, Colo.
Paul Armitage, 2174, 233 Broadway, New York City.
L. C. Boyle, Kansas City, Mo.
Rush C. Butler, Chicago, Ill.

UNIFORM COAL MINE REPORTS

S. A. Taylor, Second National Bank Bldg., Pittsburgh, Pa.
Carl Scholz, Professional Building, Charleston, W. Va.
A. H. Land, Huntington, W. Va.
Morton L. Gould, 701 Terminal Bldg., Indianapolis, Ind.
G. H. Caperton, Box 601, Charleston, W. Va.
Thomas T. Brewster, St. Louis, Mo.

OPERATORS' CO-OPERATING COMMITTEE

PETROLEUM

J. G. BRADLEY, *Chairman*
J. F. CALLBREATH, *Secretary*

E. L. Doheny, Mexican Petroleum Co., 120 Broadway, New York City.
George S. Davidson, Gulf Refining Co., Pittsburgh, Pa.
A. L. Beaty, Texas Co., 17 Battery Pl., New York City.
H. F. Sinclair, Sinclair Oil Co., 45 Nassau St., New York City.
Walter Teagle, Standard Oil Co. of N. J., New York City.

METALS

Bulkeley Wells, Hobart Bldg., San Francisco, Calif., Gold.
F. B. Richards, Leader-News Bldg., Cleveland, Ohio, Iron.
Edgar Z. Wallower, Joplin, Mo., Zinc.
B. B. Thayer, 25 Broadway, New York City, Copper.

COAL

J. G. Bradley, Elk River Coal & Lumber Co., Dundon, W. Va.
T. H. Watkins, Pennsylvania Coal & Coke Corp., New York City.
E. W. Parker, Anthracite Bureau of Information, Philadelphia, Pa.
Albert Nason, Nason Coal Co., Chicago, Ill.
J. G. Puterbaugh, McAlester Fuel Co., McAlester, Okla.
S. D. Warriner, Lehigh Coal & Navigation Co., Philadelphia, Pa.

COAL EXPORTS

Geo. S. Rice, Bureau of Mines, Washington, D. C.
John Callahan, Woodward Bldg., Washington, D. C.
Chas. A. Owen, Pres., Imperial Coal Corporation, 17 Battery Pl., New York City.
G. A. O'Reilly, Irving National Bank, New York City.

(From the Craftsman's Dictionary)

Cooperation

Cooperation—the lesson of civilization; the realization of mutual interdependence put into constructive practice.

This great lesson of civilization, that what is to the benefit of each is interwoven with the welfare of all, is becoming a constantly increasing impulse back of all commercial enterprise. This lesson is difficult to learn, and one that is advanced only through intelligent effort constantly applied. But in the economic structure of the Nation few movements are on a higher plane than this cooperative effort, and few are in position to render more definite, practical service to the whole country.

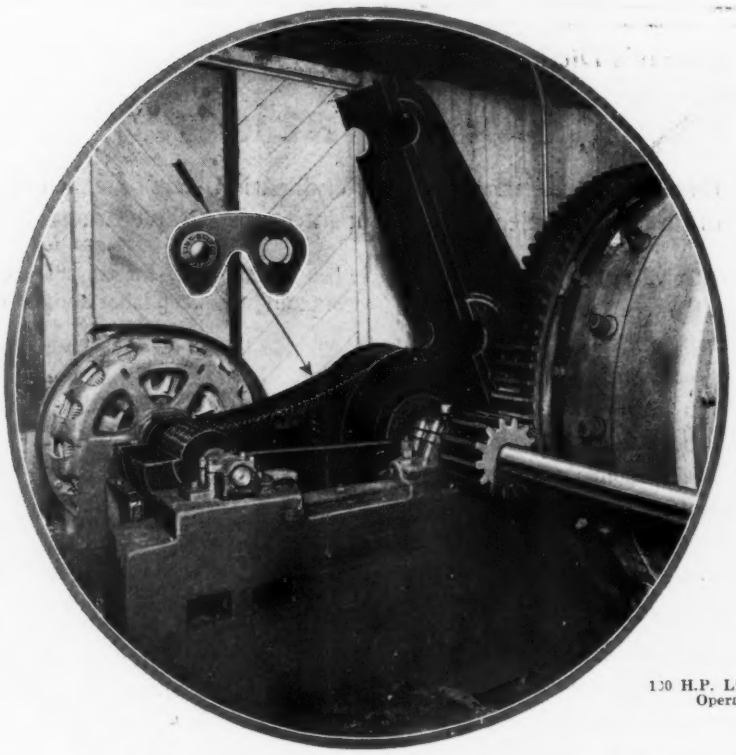
This cooperation manifests itself in many ways. One significant development is the growing movement of industrial cooperation—the leaven that has already gone far toward righting misunderstandings between labor and employee.

Another important development about which little has been said is that which has grown up between those whom we think of as competitors. Operators have formed associations that work for the common good. The engineers have their societies from which they all draw inspiration. And now equipment manufacturers are wholeheartedly cooperating with each other as well as with those for whom they work—the operator and engineer—to reduce the common burden of the expense of mining operations. Significant of this are the representative names on immediately foregoing pages of those who are promoting the standardization of mining practice and equipment.

A movement that grows with common enlightenment. Pass the good word along

INDEX TO ADVERTISERS

	Page
Allis-Chalmers Mfg. Co.	27
Ameling Prospecting Co., Inc., H. R.	45
American Brass Co.	9
American Mine Door Co.	41
American Steel & Wire Co.	27
Aurora Pump & Mfg. Co.	43
Bertha-Consumers Co.	47
Boyle, Jr., John	47
Broderick & Bascom Wire Rope Co.	Inside Back Cover
Cameron Steam Pump Works, A. S. (Ingersoll-Rand Co.)	17
Central Frog & Switch Co.	6
Central Steel Co.	19
Connellsville Mfg. & Mine Supply Co.	43
Copper & Brass Research Ass'n	29
Coppus Engineering Co.	37
Diamond Machine Co.	43
Deister Concentrator Co.	37
Dorr Co.	12
Du Pont de Nemours & Co., E. I.	35
Fawcus Machine Co.	45
General Coal Co.	49
Goodman Mfg. Co.	7
Hercules Powder Co.	3
Hoffman Bros.	47
Hyatt Roller Bearing Co.	Inside Front Cover
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works)	17
Inspiration Consolidated Copper Co.	23
Irvington Smelting & Refining Works	45
Johnson Mfg. Co., G. M.	47
Keystone Churn Drill Co.	41
Keystone Lubricating Co.	15
Knox Mfg. Co.	11
Lehigh Coal & Navigation Co.	49
Lincoln Steel & Forge Co.	4
Link-Belt Co.	54
Ludlow-Saylor Wire Co.	14
Magma Copper Co.	26
Mancha Storage Battery Locomotive Co.	18
Magnetic Mfg. Co.	36
Miami Copper Co.	24
Morse Chain Co.	Back Cover
Nevada Consolidated Copper Co.	34
New Cornelia Copper Co.	22
New York Engineering Co.	45
Nuttall Co., R. D.	10
Ohio Brass Co.	41
Old Dominion Copper Co.	20
Pacific Tank & Pipe Co.	45
Patrick, R. S.	41
Phelps Dodge Corp.	28, 45
Prest-O-Lite Co.	39
Ray Consolidated Copper Co.	25, 33
Roebling's Sons Co., John A.	13
Stonehouse Signs, Inc.	47
Thorne, Neale & Co., Inc.	47
United Verde Copper Co.	21, 32
Utah Copper Co.	34
Weller Mfg. Co.	18
Westinghouse Electric & Mfg. Co.	16
West Virginia Rail Co.	45



100 H.P. Link-Belt Silent Chain Drive
Operating Marcy Ball Mill

Six Reasons Why You Should Transmit Power With This Efficient Drive

THESE are the six most important features mentioned by hundreds of satisfied users as *their* reasons for preferring the Link-Belt Silent Chain method of transmitting power:

1. It increases production, and improves the quality of work;
2. It saves power, because it is 98.2% efficient (on actual test);
3. It eliminates slippage, giving a positive velocity ratio;
4. It materially reduces operating and maintenance costs;
5. It is compact, and operates on short or long centers;
6. It maintains its high initial efficiency throughout its long trouble-free life.

Link-Belt engineers will be glad to show you how you can use this effective drive in *your* plant, with similar satisfactory results. Link-Belt Silent Chain Drives transmit from ¼ to 750 H. P., and over. Drives ranging from ¼ to 10 H. P. are carried in stock for immediate shipment. Write today, asking for Silent Chain Price List Data Book No. 125. Address nearest office.

LINK-BELT COMPANY 2101

Leading manufacturers of Elevating, Conveying and Power Transmission Chains and Machinery

PHILADELPHIA, 2045 Hunting Park Ave. CHICAGO, 300 W. Pershing Road INDIANAPOLIS, P. O. Box 85

Offices in Principal Cities

LINK-BELT

THIS YEAR LINK-BELT IS FIFTY YEARS OLD

SILENT CHAIN DRIVES

INDEPENDENT of all surface conditions, a Broderick & Bascom Aerial Tramway keeps your ore, coal or mill output moving the year round. Especially recommended for haulage in hilly or "broken" country. Installation costs frequently absorbed in a few years by economy of operation.

Where the fall is sufficient, tramway operates by gravity. Otherwise, steam, electricity or gasoline power can be used. B. & B. Friction Grip Aerial Tramways require a minimum number of attendants. The Two-Bucket Type (for short hauls) requires but one man. Satisfactory operation of both systems absolutely guaranteed.

For full working details, write for illustrated Catalog 37.

We manufacture the famous heavy-duty Yellow Strand and other reliable hoisting and haulage ropes

BRODERICK & BASCOM ROPE CO., St. Louis, Mo.

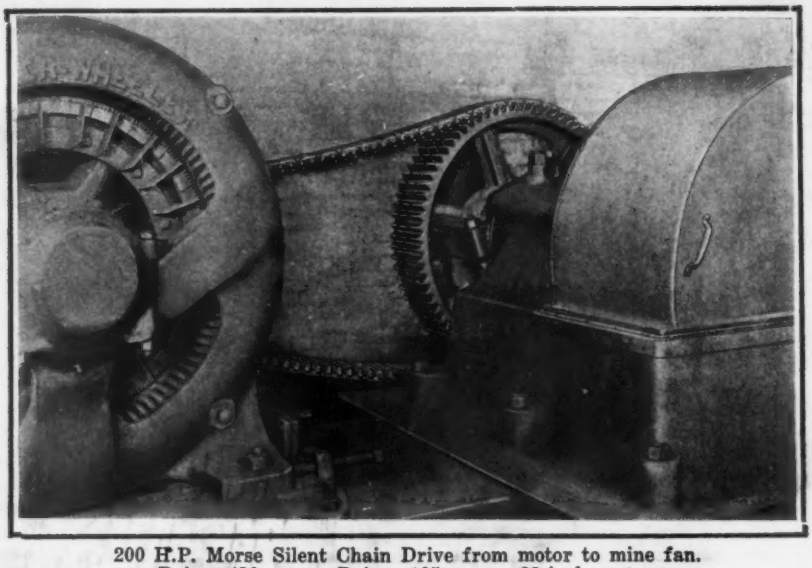
Eastern Office and Warehouse: 76 Warren St., New York City
Western Office: Seattle Factories: St. Louis and Seattle

B and B Aerial Tramways

IR596

MORSE SILENT CHAIN DRIVES

THE MORSE "ROCKER JOINT"



89

200 H.P. Morse Silent Chain Drive from motor to mine fan.
Driver 430 r.p.m.; Driven 105 r.p.m.; 88-inch centers

BELOW GROUND OR ABOVE

Wherever dependable power transmission or speed reduction is an important consideration, apply Morse Silent Chain Drives

THE ORIGINAL ROCKER JOINT CHAIN

Noted for

Sustained efficiency—98.6%.
Positive speed ratio between shafts.
High ratio of speed reduction.
Quietness at all speeds.
Convenience of application.
Reliability, long life, low upkeep.

More than 4,000,000 H.P. installed. One quarter to 5,000 H.P., 6,000 to 250 r.p.m. or slower. Especially effective on short centers

Consult Morse engineer at nearest office

MORSE CHAIN CO., ITHACA, N. Y., U. S. A.

There is a Morse Engineer near you

ATLANTA, GA., 702 Candler Bldg., Earl F. Scott & Co.
BALTIMORE, MD.....1402 Lexington Bldg.
BIRMINGHAM, ALA...Moore-Handley Hdw. Co.
BOSTON, MASS.....141 Milk St.
CHARLOTTE, N. C...404 Commercial Bk. Bldg.
CHICAGO, ILL.....112 W. Adams St.
CLEVELAND, OHIO.....421 Engineers Bldg.
DENVER, COLO.....211 Ideal Bldg.
DETROIT, MICH.....7601 Central Ave.
LOUISVILLE, KY., 516 W. Main St., E. D. Morton Co.
MINNEAPOLIS, MINN., 413 Third St., Strong-Scott Mfg. Co.
NEW ORLEANS, LA., 521 Baronne St., A. M. Lockett Co.
NEW YORK, N. Y.....50 Church St.
OMAHA, NEB., 727 W. O. W. Bldg., D. H. Braymer Equipt. Co.
PHILADELPHIA, PA...803 Peoples Bk. Bldg.
PITTSBURGH, PA.....Westinghouse Bldg.
SAN FRANCISCO, CALIF...Monadnock Bldg.
ST. LOUIS, MO.....2137 Ry. Exchange Bldg.
TORONTO, 2, ONT., CAN...50 Front St., E., Strong-Scott Mfg. Co.
WINNIPEG, MAN., CAN.....Dufferin St., Strong-Scott Mfg. Co.

658

RANSDELL INCORPORATED, PRINTERS, WASHINGTON, D. C.

XU